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INDUSTRIAL DESIGN

INDUSTRIAL DESIGN

A PRACTICAL GUIDE

BY

HAROLD VAN DOREN

*Van Doren, Nowland and Schladermundt
New York and Philadelphia*

TWELFTH IMPRESSION

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NINTH PRINTING

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To

C. L. V. D.

Diogenes' long quest was ended. . . .

Acknowledgments

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HAROLD VAN DOREN.

VAN DOREN, NOWLAND, AND SCHLADERMUNDT
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Introduction

INDUSTRIAL design, as the term is used in this book, has been recognized as a specialized pursuit for little more than a decade. Although its principles and procedure have as yet barely jelled, the need for a book of method is already apparent. With interest rising rapidly, there is still no literature for the beginner, and schools have only begun to meet the problem of adequate teaching.

The job of an industrial designer is to interpret the function of useful things in terms of appeal to the eye; to endow them with beauty of form and color; above all to create in the consumer the desire to possess. To accomplish these things one needs not only talent but technique.

No book can hope to create talent, but it can supply a background of technique. If you have aptitude without training, a book can help you to circumvent some of the avoidable errors that established designers made in the beginning for lack of just such a guide.

In these pages will be found no rhapsodies about the future of this new profession. Its brief past has been full of eager prophets and overfanciful press-agentry. Perhaps in the beginning some spectacular ballyhoo was needed to awaken interest. But now that some of the bloom is off the peach, the daily job of designing merchandise for appearance should be revealed for what it is; a serious profession that requires persistence, industry, and an unusual variety of technical skills.

Stripped of hocus-pocus, the goal of design is sales—at a profit.

For ten years the author has practiced this new profession with no thought but to create merchandise that the public would buy. To add the role of teacher temporarily to that of designer

is a task he has undertaken only with a view to speeding the day when design will be given its place in the industrial world with as little question as engineering, advertising, or management itself.

If, therefore, this book inspires anyone to enter a field which the author believes to be as important artistically as any of the so-called fine arts, he will be happy. But this is a text. It is not a romance to thrill the novice with tales of easy success and hints of princely emolument.

The hope is further cherished that this volume may give impetus to the teaching of product design in industrial and vocational schools, in art institutes, in colleges, and in universities. Few courses are being offered as yet, largely for lack of experienced teachers, but in part for want of an anchor to windward in the form of a textbook. The time will surely come when no engineering course will be considered complete without at least some elementary training in design-for-appearance.

The book is aimed primarily at the young person making his choice of a vocation. But it is also addressed to engineers and draftsmen who may have appearance problems to solve; to commercial artists and advertising men who may wish some insight into the mechanics of appearance design; and finally to business executives, with the hope that it will bring into focus some of the intricacies of designing their own products and thereby create a more sympathetic understanding between them and the men they engage to perform this highly specialized service.

In many quarters the impression still persists that industrial design is like an eleventh-hour costume for a fancy-dress ball, to be put on just before the product goes to meet the public. On the contrary good looks must be built in, not draped on. The designer worthy of the name is blood brother to the engineer.

Public taste, merchandising techniques, and fabrication processes are changing from day to day. Little effort, therefore, will be made in these pages to give solutions to particular problems, although in Chaps. IV, XXVI, and XXVII a few such solutions will be touched upon. The book offers, rather, a method for attacking a problem. It describes as specifically as possible the means of gathering data and materials and of

organizing them into usable form, together with the measures necessary to carry them through to a successful and practical conclusion.

The book is divided into four parts:

Part I, *The New Profession*, is general in its nature. It will give the young person surveying the field as a possible life work some conception of its scope and its many difficulties. It will tell him how to prepare for it, where he may expect to gain a foothold, and how to base fees for his work.

It is also designed to give business executives and engineers a clear idea of how the industrial designer operates, what he can do for their business, and how much to expect from him after he has been engaged.

Part II, *Fundamentals*, is an elementary treatise on designing in three dimensions. Most books on design have suffered from one of two faults: either they have been too involved for the average reader or they have presupposed too much previous knowledge of the subject. An attempt will be made to avoid both errors. This part will make a particular point of being clear and simple, taking nothing for granted. It will hark back to the most elementary concepts of design, the most primitive forms. Then, by means of allusion and example, it will try to construct a foundation on which the novice may in the future erect a more subtle and sophisticated design structure.

Part III, *Technique*, will be of use both to the student and to the young designer just beginning his career. It tells how to gather preliminary data; how to organize it systematically; how to make rough sketches, renderings, models, and name plates; how to present design ideas most effectively to the client. There are chapters on materials and processes, design patents, and color, and, for the benefit of the designer trying to gather an organization about him, suggestions for the efficient management of a free-lance studio.

Part IV, *Practice*, offers first a few problems for the beginner, suggesting a number of possible solutions for each. The concluding chapter of the book gives actual case histories describing, step by step, the development of three products already on the market: one a consumer product, one a commercial product, and one item in the machinery class.

Part I · The New Profession

I · The Scope of the Book

IN THE broad sense, design applied to articles for use is the oldest of all the arts. It antedates painting, sculpture, even architecture. But in the limited meaning used in this book, it is still in its infancy. Therefore it will be only sensible to describe at the outset the precise province of industrial design as the term will be used in succeeding pages.

Industrial design is concerned with three-dimensional products or machines, made only by modern production methods as distinguished from traditional handcraft methods. Its purpose is to enhance their desirability in the eyes of the purchaser through increased convenience and better adaptability of form to function; through a shrewd knowledge of consumer psychology; and through the aesthetic appeal of form, color, and texture.

Handcrafts are excluded for reasons to be given later. For the moment let us merely point out that the designer's chief task is to make useful things more useful still. Beauty as such, instead of being his primary concern, is rather the end product of a blending of texture, shape, and color with the particular function the machine performs.

Although incidental to these endeavors, it is vitally important to their ultimate success that the designer should be able to get the most out of available materials at a cost which will encourage widespread distribution.

THREE GROUPS

The products and machines encompassed by our definition fall naturally into three groups:

1. *Consumer products:* including domestic appliances for heating and ventilating, housecleaning, preparing and serving food,

and washing and ironing clothes; illuminating equipment and sanitary fixtures; radio and television receiving sets; smoking accessories; garden implements and outdoor furniture; luggage; toys and juvenile vehicles; novelties; in fact any of the thousand-and-one articles bought and used by Mr. and Mrs. Average Citizen.

2. *Commercial equipment*: including display fixtures, cash registers, scales, and refrigerators; soda fountains, beverage mixers, coffee urns, and merchandise dispensers; desks, filing cabinets, dictating machines, typewriters, adding machines, and safes; gasoline pumps, hoists, and lubricators; barber chairs, permanent wave machines, and hair driers; dental units, X-ray equipment, sterilizers, and electrotherapy machines; or any other device, not consumer-owned, which is used directly or indirectly to render some service to the public.

3. *Capital or durable goods*: including machine tools, contracting equipment, food machinery, agricultural implements, industrial furnaces, power units, generators, control devices, switchboards, call systems, printing presses, stokers, hoists, pumps, transmissions, motors, and other machines in endless variety.

Most of the products in these three groups were in common use before the advent of the modern industrial designer. Some, like chinaware and lighting fixtures, were regarded as perfectly natural subjects for artistic treatment. Others, such as washing machines, typewriters, and drill presses, were not.

For instance, it hardly needs to be pointed out that the most important thing about a china teacup is its appearance: its shape, color, luster, surface pattern. To design a really beautiful china teacup requires artistic ability and technical knowledge of a high order. But the traditions of the ceramic art go back to the Pharaohs of Egypt, and the special technique involved is dealt with in other books.

By limiting our horizon to articles made by mass-production techniques, we automatically shut out several fields where artists have been *traditionally an important factor in manufacturing and merchandising*, that is, ceramics, glassware, textiles, silverware,

jewelry, wallpaper, and furniture. These are sold, and always have been sold, largely on appearance, whereas, in the manufacture of engineered products like typewriters, utility and price were the prime concerns of manufacturer and purchaser alike until a few years ago.

The designer of textiles or wallpaper will likewise find little to interest him here. His is a one-man job, his design problems are two-dimensional. The industrial stylist, on the other hand, can accomplish nothing without the close collaboration of experimental men, engineers, and production specialists, and his design problems are almost exclusively three-dimensional.

Wooden furniture and hollow silverware (as distinguished from flatware) must also be excluded. Their manufacture is still largely manual and involves problems of craftsmanship so remote from those of the mass-production industries that they can hardly be discussed in the same volume.

It becomes apparent, then, that the modern industrial designer works chiefly with two classes of materials: the baser metals such as iron, steel, zinc, and aluminum, which most designers of a former day neglected; and the synthetic plastics, which were almost unknown twenty years ago. I do not mean to imply for a moment that the handcraft and mass-production fields must be kept in watertight compartments. They need not be mutually exclusive. If designers can successfully serve both fields—and some do—so much the better. No single book, however, can hope to deal with both.

HAND VERSUS MACHINE

A specific example may help to point up the distinction I am striving to make. Let us go back to our teacup. The molds required to produce a china teacup are inexpensive. Therefore a large number of styles can be made and tested on the market without a heavy initial penalty. Successful styles can be retained and the poor sellers dropped.

Now let us look into the future and imagine that a synthetic plastic had been developed possessing all the qualities necessary to replace china, plus a few advantages of its own such as increased resistance to breakage. Teacups made from this material would probably be produced in hardened steel molds under heat

and pressure. These molds would cost a hundred times as much as the molds for a china cup. Huge quantities would have to be sold to get back the tool and die investment. The designer's responsibility is thus multiplied a hundred fold because he must be pretty sure he is right before the molds are made.

The china teacup, because it is not a machine-made article, is outside the domain of industrial design as described in this book. The plastic teacup is not.

There are, of course, certain borderline articles made both by hand and by machine, and many products combining traditional as well as modern materials. Glass containers and some tableware items are made on fully automatic equipment, and the production of textiles is largely a mechanical operation. Textiles may, of course, be used in conjunction with outdoor metal furniture; glass in conjunction with steel. Yet the fact remains that glassware and textiles as such have traditions that go back centuries before the engineered products we are here concerned with were even dreamed of.

One field definitely in the mass-production group must also be omitted: transportation. Every ambitious lad who has had a night-school course in drafting thinks he is ready to design snappy sport cars and streamlined trains. He cannot be told too soon that the creation of such things may take months and even years of concentrated effort by a whole staff of specialists. Transportation units are complicated assemblies of many components. Although the principles and technique set forth in this book would be applicable to any one of these components, and frequent analogies to transportation will be found, as a field of design it is too huge and too diverse to be stressed here.

There is but one Twentieth Century Limited to 10,000 cash registers, lawnmowers, and teakettles. It is quite as important to design everyday merchandise successfully—and sometimes just as difficult—as to create the last word in rear-engined motor cars.

THE DIFFERENCE IN MATERIALS

The artist-craftsman of a past generation spent his life working with a single material: gold, silver, porcelain, or crystal. The

materials which the modern industrial designer employs in creating the articles of modern commerce are almost numberless, and, for every material, he may call into play a dozen different processes.

The chasm between the old and the new, however, is not merely in materials, but in fundamental technique and approach. Master silversmiths and potters fashioned their wares with their own hands; the feel of the metal or the clay was in their blood, and the resulting coffee urn or vase was an intimate synthesis of maker and material. In the mass-production industries the kitchen range or the vacuum sweeper must be brought to perfection on paper, in the model shop, and in the experimental laboratory. From then on the designer never touches the actual materials again; the process of reproduction in countless thousands is the work of cold steel, guided by alien and often indifferent hands.

Every product of the craftsman bears the maker's personal mark. The products of industry bear only the impress of the designer's mind.

There is a school of thought which holds that the modern designer, too, must manipulate each material of manufacture with his own hands, else he will never be worthy to create in that medium. This is true only to a limited extent. To be sure he must appreciate the difference in texture between iron and aluminum. He must approach the plastics in an entirely different spirit from glass. But I cannot go all the way with this extreme belief.

There are a few remaining processes where craftsmanship still plays a part in modern manufacture. It will do you an infinite amount of good, if, in designing a coffeepot or a lamp reflector in spun aluminum, you can work for a time at a spinning lathe in order to know the possibilities of that particular process. If you stand at a polishing jack and buff a plated die casting yourself, watching the gleam of the chromium emerge, you will be able more intelligently to design hardware and other plated parts. But far more products involve stamping, die-casting, molding, and steel fabrication than these semimanual processes. You can learn as much by watching many processes as by doing them.

The important thing is to know their potentialities and their limitations since you can no longer yourself wield the tools that produce the finished article. You must learn to employ these processes intelligently, not straining them beyond their normal limits to the point where they become too complicated or too costly. But you should not forget that new materials are being developed in research laboratories every day, and that processes become more flexible only when new demands are made upon them.

Above all, you must learn to use materials honestly and simply. You must become familiar with the applied finishes and the available platings and learn how they may best contribute to the unity of your design. You must take pleasure in the warm and simple surfaces of the synthetic plastics, and not torture them with irrelevant decoration or try to make them look like onyx or mahogany. You must not design space heaters in cast iron and then grain them to look like wood. To have the "feel of the craft," however, in designing a saucepan or a furnace is an impossibility on the face of it.

II · Background

PRIMITIVE man began centuries ago to create utensils for living. Apparently he felt the need for beautification almost as soon as he had devised the utensils themselves, for archaeologists have found weapons, vessels, and tools of many tribes and many cultures which for rare beauty of design and perfect adaptation of form to function are the envy of every appreciative artist.

As these artistic remains of ancient peoples drift into modern museums, they are usually classified as “decorative arts,” a convenient label to distinguish them from painting, sculpture, and architecture. The casual visitor whiling away a few hours at a museum is prone to pass them by in favor of the more obvious attractions of painting and sculpture. Yet among those precious relics are to be found the artistic ancestors of the utensils, appliances, and furniture we use today. Their lineage is quite as respectable as that of the art of painting, and they touch our lives at many more points.

The next time you feel a museum-day coming over you, ask to see the gorgeous wine bowls of the Han and Chou dynasties in China, cast in bronze and covered with intricate symbolic designs. Look for ancient Egyptian amphorae and pottery from Cyprus; seek out Scythian bronzes, with their deftly stylized animal forms and the handsome burial bowls from our own Mimbres Valley in New Mexico. You will soon realize that such design as we have today has its roots in the dim beginnings of civilization.

Do not stop there. If you have the patience and the will to learn, watch that same human desire to glorify the commonplace bloom afresh among the Greeks with their subtly contoured vases and their metal mirrors with richly wrought handles;

trace it through the enamels of Byzantium and the colorful pottery of the Persians, up through the Italy of the Renaissance, the France of the Louis, and the Spain of the Hapsburgs—all teeming with evidence of man's eternal concern with the beauty of articles in use.

About the fifteenth century the arts of man began more and more to be divorced from useful ends. In the pictorial and plastic fields, instead of mosaics or frescoes used as adjuncts to architecture and statues carved for the adornment of cathedrals, paintings and statuary became ends in themselves, objects that could be moved from house to house and city to city. Sculpture in the time of the Greeks and the Romans had to some extent made this leap, but during the centuries that followed until the Renaissance it became again largely an accessory to architecture.

ART FOR ART'S SAKE

The conception of art as a thing-in-itself, a luxury for the affluent and an ornament to leisure, grew steadily until, by the middle of the last century, the artist painted pictures or carved statues without regard for their setting, without any particular relation to the stream of life about him. He worked when fickle inspiration moved him, and feasted or starved at the whim of an even more fickle public.

While the painter's star was in the ascendant, that of the designer declined. He sank to the estate of a mere artisan, a worthy fellow, perhaps, but lacking the romantic glamour of his brother of the flowing neckwear and the *vie de Bohème*. In some circles that same feeling still persists, so that the man who designs beautiful silverware or colorful pottery is felt to be, as artist, several cuts below his fellow whose bent is for portraits or bronze fountains.

My purpose, however, is not to debate the relative aesthetic merits of the arts, but rather to point out wherein the new profession of industrial design differs from the allied decorative arts from which it sprang. The industrial artist has always been with us, usually anonymous, often rather ineffective. The furniture, carpets, silverware, and glass that our grandmothers owned did not just happen. Someone made drawings for them, or

fashioned them as they went along on lathe, loom, or bench. Back of all man-made articles has been design effort of some sort.

After the Industrial Revolution, however, in the early nineteenth century, an ever increasing number of mechanical contrivances came into existence for which there was no precedent. They grew, blossomed, and matured without the benefit of artistic design. Indeed their inventors at the outset were so concerned with function that they had no time to bother with such irrelevancies as balance of form and harmony of color.

And rightly so. Lawn mowers, iceboxes, typewriters, washing machines, telephone sets, carpet sweepers, and automobiles had first to be proved useful, laborsaving, and comparatively trouble-free if, as contrivances, they were to survive. What change, then, has prompted the manufacturer to turn to the artist for help in improving the appearance of these devices and appliances? What new factors, what process of evolution, what *need* that did not exist before, has made the trained hand and eye imperative in developing these mass-produced machines?

QUANTITY SELLING AND COMPETITION

To answer the first question, there were two prime causes of the betrothal of art and industry: mass sales of identical objects, and competition.

Why mass sales? Because fifty ancient washing machines, scattered throughout a large city, are lost in the shuffle. But fifty thousand, all equally ugly, in use in homes and displayed on salesroom floors, would be an abomination. Fifty funny-looking horseless carriages, vintage 1904, were merely a curiosity and a nuisance in New York City at the turn of the century. But five hundred thousand rickety jalopies with acetylene tanks on the running boards and mudguards flapping, turned loose in the canyons of Manhattan at five o'clock on a business day next week, would be unbelievable.

To put it less obliquely, increased acceptance has a natural tendency to induce better appearance. This evolution was taking place, although not at so rapid a pace, long before the industrial face-lifter came on the scene. Although engineers themselves were not particularly conscious of it, their continual effort toward functional improvement, toward simplification of

operation for the user, tended automatically to create a smoother, more modern look.

Take the typewriter. The first writing machines were incredibly clumsy. Gradually, as volume of sales increased, they became smaller, more businesslike. Although parts increased due to the demand for greater versatility, the machines became more compact, more comely because better engineered.

Or look at electrical iceboxes. When the idea of mechanical refrigeration was first introduced, compressors were so large and so noisy that they were put in the basement and cabinets were little more than a crude metal box on stilts. Now, with millions of units sold every year, the refrigerator has become the sleek, sanitary monolith we know today.

As long as any new device was still a curiosity, the public was chiefly interested in how it worked and what it would do. When that device became a commonplace, the selfsame public demanded that its ill-favored bumps be smoothed out, its mechanical look altered, made less blatant, less assertive. Today, with industry acutely conscious of the sales benefits of good looks, styling and mechanical development of new products are more likely to go hand in hand.

"But what about the Model T?" you ask. "Ford continued to build cars along the same lines year after year without change." Well, not exactly. Visit the Ford rotunda at Dearborn and see the gradual evolution that took place in the Model T over a period of years. Although no attempt was made at streamlining as we know it today, the old high body dictated by rutty roads began to hug closer to the ground. Tops were reduced in height. Fussy brass lanterns gave way to simpler headlights.

Unfortunately Ford's production was so enormous that radical changes became progressively more difficult to make until his hand was forced by the rivalry of better styled competitive models. Yet once he took the step he has been a leader in design for appearance.

The entire process of product evolution has of course been aided and abetted by cause number two, competition. When a manufacturer has a field all to himself he can dispense with good appearance. It is a luxury. But when the field becomes crowded,

and the differences between competitive makes become increasingly difficult to detect, then good appearance becomes a necessity. The smart manufacturer uses every device to gain a legitimate advantage, and design has proved to be a new and rather potent device with which to squeeze out those last few sales that may mean the difference between profit and loss.

ENTER THE INDUSTRIAL DESIGNER

The decade of the 1920's witnessed tremendous industrial expansion. Purchasing power was at its height, electrification of homes was increasing apace, roads were being paved with dizzying rapidity, and the material standard of living for the mass of people with moderate incomes suddenly shot skyward. It was a buying market; but as the decade drew to a close, it was evident that a saturation point was being approached, if not actually reached, and that competition was making easy sales not so easy.

The emergence of the modern industrial designer towards the end of that decade was no mere accident. He put a timid foot forward about 1927. Then when the depression supervened, his place in industry became suddenly twice as important. Sagging sales curves sent executives in frantic search for some stimulus that had not been tried before, and designers who had been struggling to get their foot in the industrial door suddenly found themselves invited into the inner sanctum and swamped with commissions.

It must be freely admitted that, from many points of view, they were ill prepared for it. Among them there were capable painters, architects, stage designers, sculptors, advertising artists, even typographers, but, as industrial designers, they had almost everything to learn. Here in industry was a golden egg and, for lack of specific training, they almost killed the goose that laid it. It is a tribute to the patience of the manufacturer and the tenacity of the early designers that design is so firmly entrenched today as a potent factor in industry. Today few concerns of consequence fail to recognize that a strong appeal to the eye sends fresh troops into the sales battle.

It is odd, too, that few of today's successful designers to industry were recruited from previously existing fields of design.

And only two or three had had engineering training or were in the least familiar with the problems of drafting room or shop. One might have expected that the same artists who were designing furniture, glass, silver, and textiles—being already in the business of beautifying things common to everyday life—would leap into the breach and turn their hands to filing cases, turret lathes, and furnace stokers.

Perhaps it was because the older school of decorative artists had become so accustomed to the specialized techniques of their own fields that they found it impossible to adjust themselves to other demands. Or, to put it in a different way, perhaps the newcomers, whose initial training was of a broader and more catholic kind, were able to grasp with greater ease the requirements of an unformed profession which as yet had no traditions of any kind.

However that may be, there is no denying that some of us had never used a T-square or tried to read a blueprint when we set sail on the uncharted seas of an art that was half aesthetic and half technological.

A LOOSE TERM

The whole profession is so new that there has even been considerable difference of opinion about what to call it. The most favored term, "industrial design," is not so accurate as it should be. The engineer who conceives a new machine or appliance, builds an experimental model, makes or supervises the drawings, and eventually sees it through to the point of production is certainly the designer of that machine. And, since his sphere of activity is industry, he is, therefore, an industrial designer.

All too frequently the artist who merely puts presentable clothes on the engineer's baby steals the spotlight, although surely his contribution is less important than that of the inventor. Then, if he is a good showman, the agency handling the account may play up his name in national advertising, and with the general public he acquires the undeserved reputation of being inventor and artist, all rolled into one. Meanwhile the man who made the machine work hovers glumly in the background under a cloak of complete anonymity.

I am not implying that designers have not proved themselves mechanics and inventors too. There are scores of mechanical patents to their credit, but invention, with them, is usually a by-product of design for appearance. The manufacturer commonly engages them without counting on their mechanical ingenuity. In Chap. IV, I shall speak further about the designer as inventor.

Some in the profession have preferred to call themselves "product designers." "Industrial stylist" also seems to be gaining particular favor; at least, "to style" is common as a verb, but the word is unfortunate because it smacks of millinery, and suggests exactly the sort of superficial dressing-up job that a good designer does *not* do.

A number of years ago when the profession was brand new, a representative of one of the nationally known city directories walked into my office. When I told him that we were industrial designers, a puzzled look came over his face. "Advertising artists?" he asked. "No, we design products." "Then you're engineers?" "No, we style manufactured articles." At the word "style" his face relaxed. "Oh, I see, you're fashion artists!"

Language is made by the people who speak it, not by the schoolmasters. If I were asked to give the new profession the most accurate name I could think of, I should call it "industrial product appearance design." Too long, of course; no one would ever use it. Meanwhile most of us will continue to be asked by our clients either to "style" their products or to "streamline" them. We shall hear more about streamlining later.

III · The Designer's Place in Industry

IF APPEARANCE design is really important to the scheme of things industrial, just where does the designer fit into that scheme and what is his relative importance? What should be his precise relationship to the various departments of the business he is serving? And how will he function within the existing framework of industry?

Art, even combined with mechanical ingenuity and merchandising spark, is still suspect with some hard-boiled businessmen. It smacks of afternoon tea and Greenwich Village. Unfortunately there has been just enough slapdash superficiality masquerading as industrial design to give credence to their patently unjust conclusion that the entire brotherhood is a pack of incompetents.

It may be a matter of years before the designer will find his proper level in the kingdom of commerce. To picture him as the savior of industry, the fair-haired boy with the magic wand who can always make sales curves hit the ceiling, is just as false as the opposite extreme. Somewhere between the two he will find his eventual place.

Once the industrial designer had made a dent on industry, it was perhaps only natural for him to exaggerate his own importance in the scheme of things. Indeed, one might almost say that he would not be a good designer unless he had that sort of excited enthusiasm that makes salesmen sell and designers create. But in sober moments he must have realized that, important as his contribution might seem to him, its relative importance might not be so great. As a rule the artist is, and should be, only one of the gears in the train that includes management, sales

promotion, advertising, engineering, research—all those departments making up the complex mechanism of modern commerce.

Therefore it may be instructive to take one imaginary business setup apart to see if we can determine just where the designer fits.

A BUSINESS FABLE

Empirical Manufacturing Company is one of the two or three pioneers in the sewing-machine business. Its products are nationally known, but through the death of one of the key executives, the expiration of valuable patents, and a bit too much self-satisfaction, sales are on the downgrade. Smart and none-too-scrupulous competition has suddenly reared its head, and the company realizes that from now on it will have to fight for its markets every inch of the way.

It is still a large and well-established firm, however, with sound traditions behind it, a reputation for fairness and loyalty to its dealers, and a thoroughly trained service organization. "Empirical" is still a byword for sturdy and reliable construction, but in spite of rapid strides in the science of metallurgy and great advances in the casting of metals and in stamping techniques, the company has stuck to its old-fashioned foundry methods and good gray iron. Result: the machine is a heavy and graceless contrivance, contrasting sadly with competition's smart and gleaming contours. The only change made in 30 years, apart from clever mechanical improvements, is the removal of some meaningless squiggles of gold that formerly embellished its black rococo frame.

The quasi-military structure of the Empirical organization is much like that of any other American company of its size and reputation. Each officer is responsible to his superior and eventually to the commander-in-chief. The Board of Directors holds the purse strings, but has faith in the company president, a vigorous executive in early middle age. Although the board may dictate general fiscal policies, it leaves details of management, disposition of operating funds, and general merchandising policies up to him.

Under the president sit two vice-presidents, one in charge of production and one responsible for sales. The production

executive gets the finished machines on the freight cars and supervises everything that goes before that—engineering, factory operations, maintenance, service, and research. The sales executive sees that the product is kept before the public through advertising and promotion, then guides its successive moves through salesmen, dealers, and retail outlets until it reaches its eventual haven in your home and mine.

Under each vice-president are appropriate department heads, each with well-defined functions. Directly responsible to the president and ultimately to the board, is the treasurer and

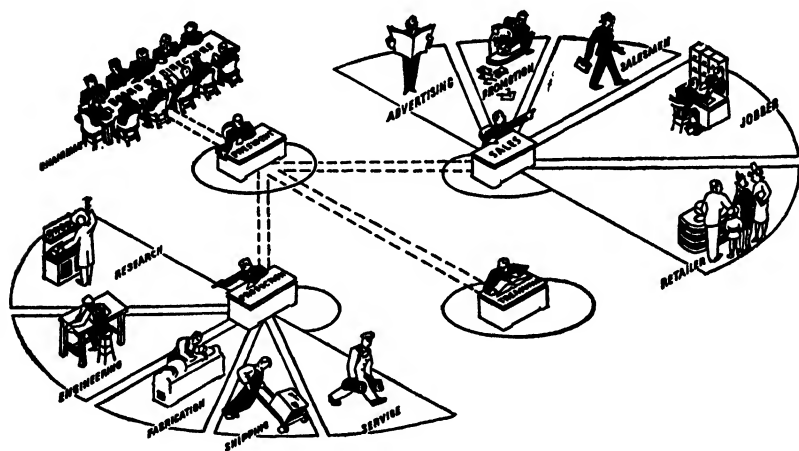


FIG. 1.

his department. Graphically represented, the setup might look somewhat like Fig. 1.

Examine the diagram closely. Has any provision been made for design? If Empirical had been a furniture factory or a chinaware concern, design would be much in evidence. A design staff would flourish side by side with other developmental departments such as research, probably operating under the aegis of the vice-president in charge of production. But since the primary function of a sewing machine is to do a good job of sewing, Empirical, like the majority of companies building engineered devices, made no provision for design when it was organized. Year after year budgets have been set up with never a red cent for style.

Empirical built its far-flung business on Model B, the regular home sewing machine. Hardly a farm over the length and breadth of the country but boasts one of these old standbys, aged anywhere from one to forty years. Villages and towns and small cities are glutted with them, but what with changes in fashions and the decline of home dressmaking, the real sales volume in Model B long ago dwindled. This was partially offset by the tremendous increase in cheap ready-to-wear dresses, sales of which set manufacturers clamoring for special equipment. Even before the depression, however, Empirical's days of rapid expansion were over.

Came the deluge. The company had reserves enough to weather the worst years, but the management simply would not read the handwriting on the wall: *smaller size, lightness, portability, style*. Strong as Empirical had always been in the rural districts, it had never paid much attention to the big cities—that vast market of small-apartment dwellers where a light, not-too-expensive, portable machine could be sold for the thousand-and-one mending and alteration jobs which the style-conscious city woman can do in spare time. Competition saw the opportunity, and before Empirical woke up, they were mopping up in the metropolitan market with a light machine made of a magnesium alloy, smartly styled.

Dealer demands can't be ignored forever, so Empirical rushed through Model K. It was aimed at this low-priced market, and introduced with tremendous ballyhoo. But it was still made of cast iron and it still looked as if it came out of the Ark. Stripped to essentials, it was merely another Model B in all respects but size. Model K was a flop.

Dealers were now in open revolt. Veteran salesmen, not easily discouraged, pleaded with the management to "Do something" about weight and eye appeal. In vain the engineers scoffed at competition's flimsy construction. "What if we do break an occasional frame," the salesmen said. "Our machines last too long anyway!" In vain the management discounted style as a factor. "We're sick of looking at the same old machine," the salesmen retorted. "Give us something new!"

Then came the word that competition had landed a stupendous order from one of the big mail-order houses. That was the last straw. Headquarters really got panicky.

Empirical was founded back in 1885 and now it is 1935. Its fiftieth anniversary should be the occasion for some kind of jubilee, but instead the company is facing annihilation. Already a Wall Street concern is making overtures for refinancing—spelling complete loss of control for the men who built the business. Something will have to be done, and done quickly.

The chairman calls a special meeting of the board. The president lays the case before them, with charts to show the precipitous slump in sales. The board disposes of the questions of weight and portability without much ado, for these matters are entirely within the scope of their thinking. "Put new blood in the engineering and research departments! Engage a top-flight consulting metallurgist! Make a thorough investigation of the new metals and plastics! Borrow money for new equipment! Abandon the foundry!"

It hurts, but it has to be done.

Style is something else again. Nobody on the board seems to know quite how to cope with the question of design. For a time discussion centers around the possibility of bringing in a designer, on salary. One member of the board plays backgammon at the club with a chap whose younger brother is a commercial artist—does illustrations for a big oil company's advertisements—why not get in touch with him? Another suggests consulting the advertising agency, and asking them to investigate. Others vaguely remember reading an article about design in some super-magazine of business, complete with a list of industrial designers.

Then someone brings up the question of where design will fit into the pecuniary structure. Should it be a sales expense? A production-minded member says "Sure." Should it be a manufacturing expense? "Of course," say the sales people. Nobody really knows what is involved, either from the company's point of view or the designer's. There seems to be a vague impression that one can go out and buy a design, perhaps at a bargain price, have it delivered complete in a few weeks' time, pay for it, and have *that* over with. The afternoon wears on and nothing is decided. Finally the president is instructed to delegate the vice-president in charge of sales to look into the matter.

Fortunately that gentleman had jumped the gun and started his own private investigation on the Q.T. Like the others he was pretty vague about design procedure at first, believing industrial design to be a kind of branch of commercial art. But he has the intelligence to go into the matter thoroughly, bring in various designers for interview to find how intelligently they approach the subject, and write to their clients for a report on how well they had succeeded for someone else. He is canny enough to discount some of the big talk they give him and size up their personalities, for he knows that some of Empirical's own staff will have to be sold, and that diplomacy is going to count. He narrows the choice down to two, each of whom he invites in to meet with the president and the production chief. A retainer fee is finally agreed upon with the winning candidate and a contract awarded.

SPHERE OF INFLUENCE

In this hypothetical case history the investigation devolved upon the sales department, although industrial design is just as much a factor of production as it is of sales. It is true that the clamor for better appearance more often comes through the sales department than through any other channel, but once the contract is awarded, the designer will spend weeks and months working out manufacturing problems before sales will ever get a crack at the finished product.

Now that Empirical has made the plunge, it may be interesting to see if we can show graphically where the designer's "sphere of influence"—as they would say in international diplomacy—will lie. Figure 1 showed the Empirical structure before design played any part in the company's operations. Figure 2 is the same diagram redrawn to indicate quantitatively, in various shades of gray, the designer's relationship to various departments of the business. It is surprising, when analyzed in this way, to find how much he impinges on all departments. His work is certainly of interest to all the top executives, save possibly the treasurer. If he does a good job, his influence will be felt there too, although he may have little actual contact except in the form of signatures on checks.

If Sales is aggressive, the designer's contacts with its various members will be constant and intimate, and, as the design nears completion, he will work closely with the advertising department, or the agency, or both. No less intimate will be his relations with Production, from vice-president to shipping room. (The entire design program may be wrecked because of carton or crate requirements.) By the time it is translated into detailed shop drawings, cost accountants will have a final whirl at it, and it will stand or fall by the result of their calculations.

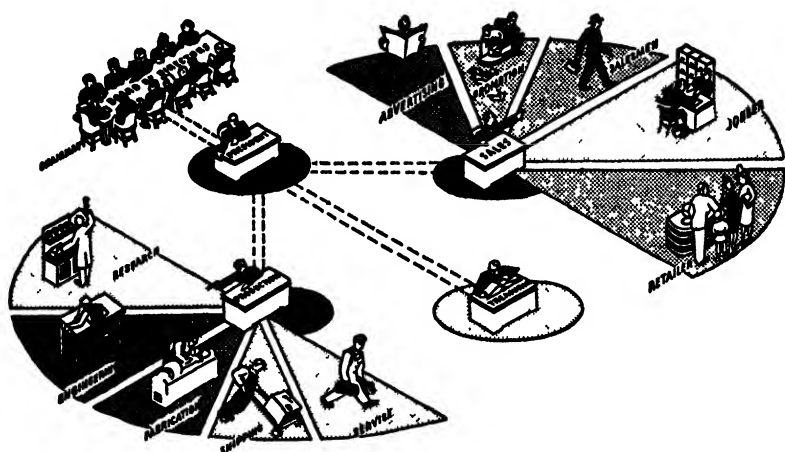


FIG. 2.

A designer with the multiple gifts of artistic ability, mechanical sense, and merchandising wits may become indispensable to his client if these talents are permitted full scope. He should be careful, however, not to overestimate his importance by taking the attitude that appearance and appearance alone is of value. The best designed product in the world cannot be sold without clever promotion, nor will it make a profit for its sponsor if it lacks sound engineering and has been made by uneconomical factory methods.

CONFIDENTIAL INFORMATION

Designer-client relations must always be confidential. Like the family doctor, the wise designer never reveals his patient's

secrets. He should not work on competitive accounts at the same time, not only because he cannot give his best efforts to two similar products, but because it is difficult not to let some slip of the tongue reveal valuable information.

Furthermore design studios are constantly visited by representatives of various suppliers. The designer must exercise caution to keep sketches, models, or other material relating to the client's products from the roving eyes of these men, who, for all he knows, may be calling on competition the next day. Neglect of such precautions has caused many a leak, sometimes ruining the entire strategy of a sales campaign. It is best to refer all such representatives first to the client and never to show prints or drawings to anyone without written authorization from the proper source.

It is equally important to conceal information on new models from the client's own field representatives until the sales department is ready to make its own announcements in its own way. Salesmen always want something new to sell and, being only human, will lie down on the job of pushing the current model if they find out there is new grist in the mill. We were once deeply embarrassed with one of our best clients simply because a draftsman thoughtlessly telephoned a company sales representative to get some quick information. In no time the glad tidings that a new model was in the making had spread from New York to California and from Canada to the Gulf.

In return for exclusive services, clients should show equal trust in the man they have chosen to give them professional assistance. He needs every scrap of information germane to the problem: present costs; present and past sales results and future quotas; an outline of the dealer setup; future sales aims—everything that may help him to understand the product and its sale. Like the company's legal counsel, the designer should know the whole story. He must feel that he is actually a part of their official family.

We were once engaged to redesign a line of products. For several months we worked actively with the engineers. Before long we sensed that the client was holding something back, keeping something under cover. It was only a vague feeling, with nothing more overt than a sudden removal of papers from a

drawing board as we entered the drafting room or the hasty closing of a desk drawer.

Eventually we discovered that the company had engaged two design organizations to work concurrently on the same project, and was concealing the fact from both! Apparently the theory was that if they engaged two designers they would obtain a better choice of designs. Actually it only served to make both feel uncomfortable, not because either particularly feared the competition of the other, but because neither was wholeheartedly in the confidence of the client.

BEGIN EARLY

The time to begin design work is when the first rough layouts of a new product are on the drafting boards. Then the development is fluid enough so that, with a part shifted here, another moved there, the designer can mold the final external appearance into a coherent whole. The manufacturer unfamiliar with the processes of industrial design usually waits until engineering is crystallized beyond change, then expects a miracle.

If the product in question involves large volume and expensive tooling, the redesign program may take anywhere from six to eighteen months. Designers, engineers, and sales executives lay out a carefully considered program so that everyone is in accord on major objectives. Engineers and designers work hand in glove throughout all the preliminary stages of development, and the product grows through a careful synthesis of the best thinking of both. Merchandising is planned early in the game, and advertising and catalogues are ready for release at exactly the right moment.

Organized in this way, a redesign program should result in reduced cost through simplification of parts and assembly, or through the use of less expensive materials. Given time and proper cooperation from Engineering and Sales, the designer should always be able to offer new features and improve buyer pulling power through greater suavity of form, more effective use of color, smarter general appearance. More design programs go on the rocks due to haste than from any other cause. The manufacturer who is not prepared to spend money at the outset for intelligent and thorough design service wastes money in the end.

An indirect service the designer renders is frequently overlooked by the manufacturer: stimulation of his own personnel. Men being only human are prone to rest on their oars. Outside design service tends to awaken creative thinking throughout every department. It puts men on their mettle, spurs them to fresh effort. By that service alone the designer often justifies his fee.

It is unfortunate but nevertheless true that the minds of some business executives are completely set against appearance design. They may have been soured by a former experience with some designer whose sales talk was persuasive but whose performance was incompetent. (There are racketeers in the ranks already, it seems.) Sheer conservatism is sometimes the reason, a reason which has to be respected even if deplored. But once in a while the door is slammed in your face with a finality that leaves you completely baffled.

Our representative once called on the president of a well-known company making office equipment. He was received with the utmost courtesy. "I shall be glad to give you all the time you want," the president said. "I will discuss any subject except industrial design." There is no answer to that. His products, by the way, are sorely in need of attention.

One type of manufacturer hard to deal with is the man who thinks he knows exactly what he wants. He believes he can clearly visualize the final design, but because he cannot draw, he has hired you to read his mind for him. He is Allah and you are Mohammed, his prophet. He is almost never satisfied with what you do, for, if he only knew it, the image in his mind is vague indeed, being made up of a hodge-podge of elements culled from competitive makes and the still more indefinite suggestions of salesmen. They, being also unable to draw, wave their hands in the air with "I think it should have a little more bulge here," or perhaps, "We ought to put more punch in our merchandise—a lot of bright chrome somewhere around there."

OBSCOLESCENCE

The rapid evolution of the modern automobile has done more than any one thing toward making America design-conscious. The automotive industry's biennial cycle, calling for minor changes one year and major retooling the next, has

spurred other fields to emulation so that the public, and especially sales departments, are quick to tire. They clamor for something new at any cost.

The tremendous production in motor cars, with the consequent rapid depreciation of tools, makes it sensible to redesign when tools wear out. The extension of the system into other fields, however, sometimes works hardships. The cost of continuous restyling, not because of design fees, but because of tool expense and constant revision of merchandising and promotional plans, tends to cancel out the advantages of mass production by keeping prices artificially high.

While planned obsolescence has become almost a matter of routine in stoves, radios, refrigerators, outdoor furniture, and other lines, it can be overdone—and often is. Is it necessary to redesign quite so often? Designers think so because it gives them jobs, but would it be amiss for the designer occasionally to act as a brake on his client, suggesting modest changes or additive features to turn the trick?

PORTRAIT OF A DESIGNER

At his best, the designer is an animator, a builder of enthusiasm in others. He is prodigal of ideas and if one proves too costly or impractical he has another on the tip of his tongue or the point of his pencil. He is resourceful; he is familiar with the standard processes of manufacture and can always see ways of improving a product within the framework of merchandising necessity, present equipment, and reasonable cost. He is creative without being crackbrained. He is practical without being timid. He knows how to work with others, meeting executives on an equal footing and still gaining the confidence of the man on the bench.

He brings to his client a broader design point of view than a man can have when burdened with the responsibilities of everyday operation. He fully acknowledges the superior technical knowledge of the men in the client's organization. He cannot and does not presume, of course, to tell them how to do things which they have learned through years of research and experience. But, through his varied contacts, he may contribute a

helpful knowledge of materials and methods gained in the plants of other clients.

Although the best industrial designer must have a genuine flair for the mechanical, he is and should be primarily an artist. The belief, however, that all artists are temperamental is pure myth. They are no more so, and probably no less, than men and women in any other walk of life. Business executives are sometimes as touchy, inconsistent, and emotionally unstable as any opera singer. Crack salesmen, too, are notoriously mercurial—up one day and down the next. I know a brilliant engineer who resigns about once a week because of some fancied slight, then has to be cajoled out of his fit of sulks and coaxed back to his desk.

Industrial designers who take their work seriously cannot afford to play the prima donna. The successful ones work ten hours a day and throw in holidays for good measure. A few years ago our organization designed a line of machine tools to be presented at a trade show, working on a schedule figured almost to the hour. Every step of the way we kept abreast of the engineers, and twice we had to wait for them to catch up.

The designer who neither overestimates nor undervalues his importance is the one who will best serve industry. And the business man who realizes the importance of design and knows how to get the best value for his design expenditure is, other things being equal, the man who sells the most products.

IV · His Creative Contribution

MANIFESTLY it is no more possible to learn how to create new design ideas from the pages of a book than to become a true composer or poet by reading works on harmony or prosody. Hence this volume deals chiefly with the minutiae of method. Succeeding chapters will take up such matters as gathering data, preparing rough sketches, and building scale models. But it may also be possible to erect a few signposts pointing the way to the sort of creative thinking that should be the aim of every designer worth his salt.

When a manufacturer engages you he rarely expects you to produce basic new inventions. Rather, he looks for changes and refinements in form which will make his product more acceptable to the buying public. But if you are genuinely creative, your contributions may amount to genuine invention. I could cite many projects, begun merely with a view to surface redesign, which resulted in fundamental recasting or even the development of an entirely new product.

Like any creative process of the mind, hatching new design ideas is an elusive business. They lurk tantalizingly in the penumbra of consciousness and sometimes no effort of will seems sufficient to coax them forth. Then at unexpected moments they leap full-fledged into being and flow onto paper with little apparent effort. One thing is certain: they will not come at all without hard work, without first saturating yourself in the problem and literally living it from every angle. The more you know about any product—its manufacture, its uses, its sales—the more readily new themes will crowd into your mind.

Your task, then, is to create something new, not merely something better looking. Let us suppose you have gone through the preliminaries described in a later chapter: you have talked at

length with executives, shopped in the market, gathered all available data, obtained copies of surveys and reports bearing on the problem. Since increased sales is the goal of industrial design, there is no better place to begin than with an analysis of the sales features of your client's product. Ask yourself the following questions:

1. What particular features does this product possess which have made it sell in the past, or which make it superior to competitive articles?

2. What features do competitors stress which would be worth incorporating (with improvements of course) in my client's product?

3. On what weakness in the product does competition capitalize?

4. What new features can I add which have never been used before?

You will notice that we are talking about ideas now, not appearance. We are trying to give the client more than he bargained for—new features, in addition to better style.

DISSECTING THE GAS STOVE

Let us lay the domestic gas stove on the clinic table for examination. For many years the family cooking unit remained, both in function and appearance, a lineal descendant of the old coal or wood-burning range of grandmother's day. The coal-burning stove was a chunky mass of cast iron, usually built down to the floor or supported on short legs. The oven received its heat from a firebox alongside. When gas came to replace coal, little change was made in design at first, except that the new-fangled burners had to be put under the oven.

Now, it is a fact that women dislike stooping to inspect the contents of an oven. With coal or wood fuel it would have been impractical to build a stove on stilts. Gas, however, could be piped anywhere, and soon the whole stove was put on legs, often with the oven on top. To our modern eyes, of course, the appearance was bizarre. The legs were cast-iron adaptations of the

cabriole type of chair leg found in eighteenth century furniture. The oven was a miraculous affair with a cast-iron door, shiny lettering, and nickel-plated corners.

Gradually improvements were added: pilot lights, a high shelf in back for matchboxes and such, removable drip pans, and mica windows in the oven.

In the old days nearly every city of any size had its stove works and distribution was largely local. But with the advent of mass production, branch manufacturing, national advertising, and active competition of large companies for sales in the same territories, the whole picture changed. Sheet metal replaced the heavier cast iron largely because of freight rates, and sheet metal also made it easier to clothe the stove in sanitary vitreous enamel. Soon the kitchen began to vie with the white-tiled bathroom as a place of beauty and cleanliness.

Then came color, together with all kinds of novel surface effects, even to such ghastly tricks as treating the porcelain to look like wood or marble—a vogue happily short-lived. Electric lights were mounted on the back rail; minute-minder clocks and automatic timers were added. Soon a light switched on when you opened the oven door; utility drawers for pots and kettles were introduced to utilize vacant space; salt and pepper shakers became standard equipment; and insulated wells gave all the advantages of a fireless cooker. Exclusive of materials and gadgets, however, the most radical change was the return, about ten years ago, to the general proportions of the old coal-burning stove. The oven went back where it had been in the first place and the range was again skirted to the floor.

In the minds of many stove manufacturers, of both gas and electric types, this was a step backward. The high oven, made possible by the introduction of fuel that could be piped or power that could be wired, saved the housewife many an aching back and singed pompadour. But once the compact clean-looking table-top style was introduced, Madame Housewife would look at nothing else. With her stove skirted to the floor, cleaning underneath was no problem. When through with her cooking, she covered the burners with a folding porcelain enamel top; her range was as clean as her kitchen table and she had an extra work surface, especially valuable in a small kitchen. If this was a

step in the wrong direction, she asked for it herself—because of appearance. In the long run public acceptance outweighs any other consideration.

As designer, what can you do to improve the gas range of today? The field seems to have been pretty thoroughly exploited. Hundreds of jealously guarded patents have been issued covering most of the improvements made in the last couple of decades. You can doubtless design new and sleeker hardware; you can put the light in a different place and change

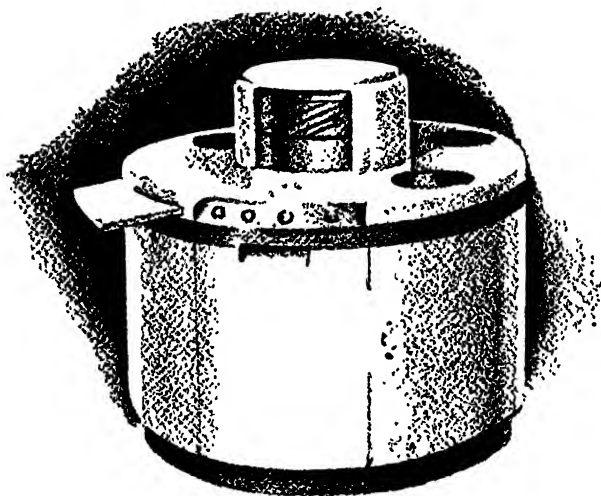


FIG. 3.

its shape; you can make the condiment shakers bob up at the touch of a button; you can smooth out the lines, changing a radius here, a line there. But that is not enough.

If you are to make a creative contribution, don't begin with details. Forget the models now on the market—all more or less the same general shape—and do a little visionary thinking with sketching pencil in hand.

THE HEART OF THE KITCHEN

If the cooking unit is the heart of the kitchen, why not make it the heart? Why not put it in the center of the kitchen instead of in its traditional place against the wall? Why not make it circular, or octagonal, or square, with access to the oven at both

sides, and burners grouped in the center with work space all around? Perhaps the oven could be at eye level and the burners at the edges, with sliding trays for work surfaces, as in Fig. 3.

Your client objects. He must have volume, and such hare-brained notions would be possible only in houses of somewhat freak design. It would mean new piping in old homes; the expense of installation would be too great. Besides, old ways of doing things are not so easily changed. It would never sell.

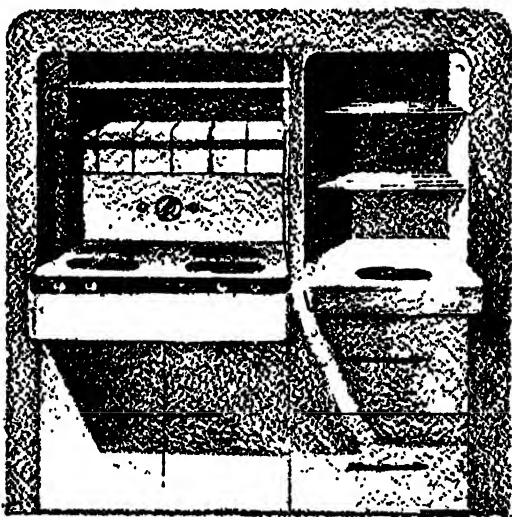


FIG. 4.

Very well, put that idea on the shelf. The range goes against the wall. Why not build it *in* the wall, with a cooking surface that pulls out when in use and a high oven over at the side as in Fig. 4?

Nothing doing. Fire laws, underwriters, and again the question of new construction versus old houses. The replacement market in old houses far exceeds possible installations in new ones. Such a scheme, even if fire hazards were not involved, would have to be a made-to-order job. The stove couldn't be displayed on the sales floor and would have to be sold from catalogues—engineered to order; it might possibly be all right for Hollywood or the crank millionaire, but not for the mass market.

If you have taken the measure of your client properly you may never submit such brain storms seriously; but it will do no harm to jot them down on paper just by way of limbering up the muscles of the imagination.

Well, back to earth again, and here is your stove, still waiting to be styled. Surely something can be done besides dressing up the conventional gadgets. What would the housewife want most in the way of convenience in cooking a meal or doing her baking? Probably she would like to get the oven back up in the air if it

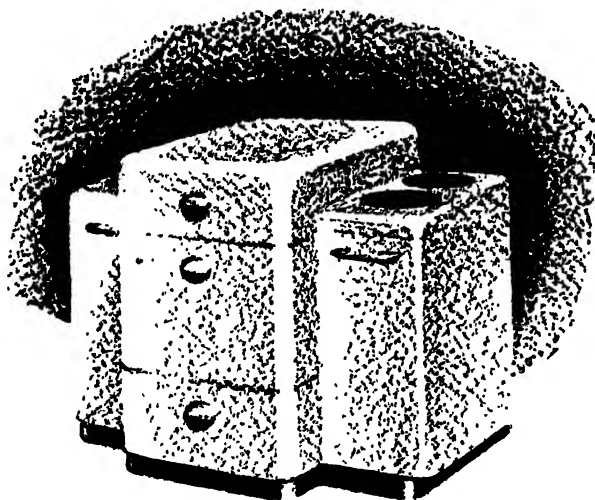


FIG. 5.

didn't make the stove look so clumsy. Perhaps you can go part way to help her and at least get it higher than it has been for the past ten years.

To raise the oven above the cooking surface at either end doesn't make a well balanced unit. Perhaps, as in Fig. 5, you could raise the center section. But the average oven is so wide that on the medium-priced stove it would leave only narrow shelves for the burners.

How large, then, does an oven have to be, you ask yourself? Roasters, a check of the various makes on the market reveals, are seldom more than 14 inches wide by about 18 inches long. Perhaps the oven need not be as wide as you had always been led to suppose. You might design the oven slightly off center, as

in Fig. 6, leaving two burners on the narrow shelf at the short side, thus giving you two burners and some work surface on the other. It's a possibility, anyway.

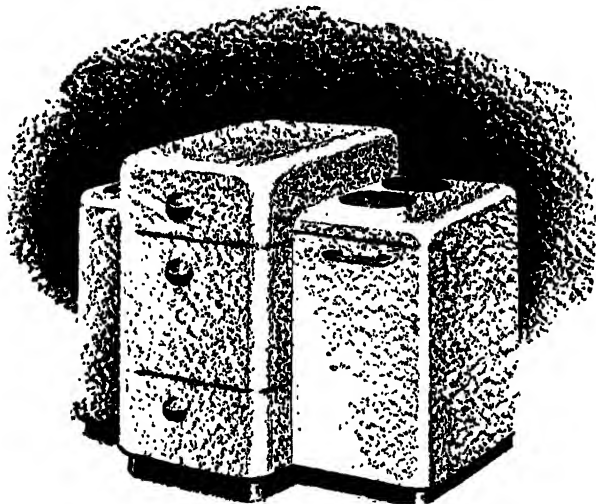


FIG. 6.

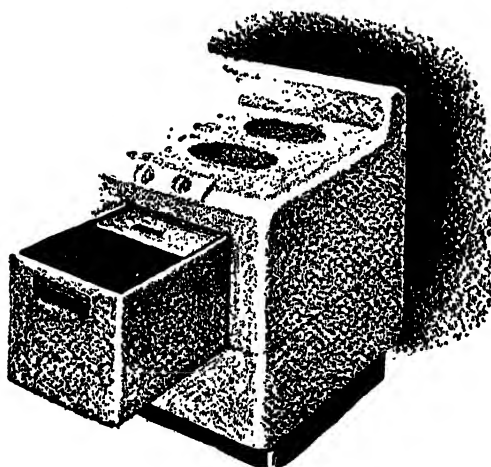


FIG. 7.

Perhaps a sketch of this gets as far as the client. The sales department says "No." The housewife wouldn't go for it. The thing still looks like the old-fashioned, high-oven range. Then

how can you keep the oven low and still make it more convenient? Why, you ask, should the oven door open *down*? The answer is, to form a shelf so the cook can slide out the roaster. Why not pull the whole oven out like the drawer of a filing cabinet? Because of heat loss, you are told. But the top could be covered with a slide which could be pushed back as far as necessary for inspection, as in Fig. 7. Score one for your side. An experimental model will be built.

Isn't there perhaps some other means by which the contents of that oven can be brought into view without so much trouble? Suppose the burners were divided, like many ranges now on the

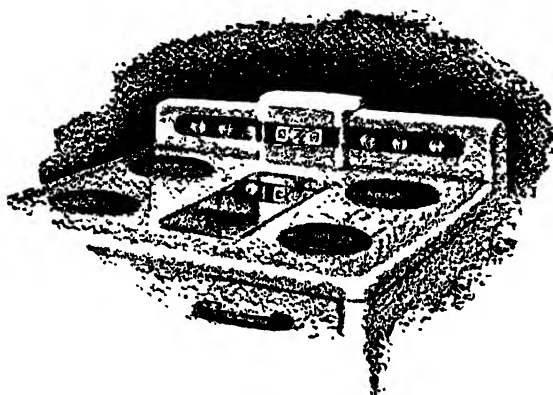


FIG. 8.

market—two on each side and a work surface in the center, over the oven? Why not insert a panel of plate glass right in the center? When an oven light is switched on, the turkey would be in full view without even opening the oven door. Can't; breakage of the glass for one thing, and moisture condensation for another. Well, the new tempered glass can be hit with a hammer and not break; and to avoid condensation the panel could be double-glazed with an air space between. Score number two for the designer. Another experimental model is on its way, as in Fig. 8.

Now examine other possibilities. You might lift the whole oven out and up, as a typewriter comes out of an office desk. You might construct a periscope with mirrors that would bring a picture of the oven contents up to eye level! Many other things present themselves. In studious fashion you explore every

avenue, wring every drop of plausibility out of the single theme of "oven convenience."

In like manner you analyze the convenience of the cooking top, study the desirability of artificial lighting and the best way to provide for it; the most convenient and safest (because of children) placing of gas cocks and thermostat; the best arrangement of utility compartments—all of this before you have given much thought to the matter of appearance per se.

No claim to originality is made in the above analysis; many of these suggestions are not new. They are merely given to show that you should think inventively and creatively before you do any actual streamlining. Skin-deep design is meaningless.

While in the kitchen, take a look at mechanical refrigerators. Again a fairly standard product, the general proportions of the leading makes being much alike: each a stamped metal box containing, in varying positions, an insulated food compartment with its evaporator and ice-cube trays, and a ventilated compartment containing motor and compressor.

Whether or not your client is in a position to do a bit of pioneering, you would be derelict in your duty if you did not indulge in a bit of visionary dreaming about mechanical refrigeration. The American woman has been sold on the convenience and economy of these spotless beauties that greet her in every electrical appliance store window. If she does not own one she covets it. Yet is she getting the utmost in convenience? In the process of evolution the modern mechanical refrigerator has narrowed down to a device that still leaves much to be desired. Let's forget what has been done to date and see what *might* be done.

REFRIGERATION A DECADE FROM NOW

The modern refrigerator, seen in plan view, is almost square. That shape is convenient to crate for shipping, but does it make the most convenient shape for *use*? After all, it was devised to keep foods at the proper temperature, but the housewife who makes a hundred trips to it every day often finds it a nuisance to move a dozen things out of the way just to get that bottle of olives at the back. Of course there are sliding shelves, but they

don't come out all the way, and they sometimes stick, and things topple over and spill.

In most refrigerator designs, too, the evaporator is a rather bulky form. It must be placed at the top because gravity forces cold air downward. Therefore most of the available shelf space is only about waist high, and causes Milady to stoop. Can anything be done about it?

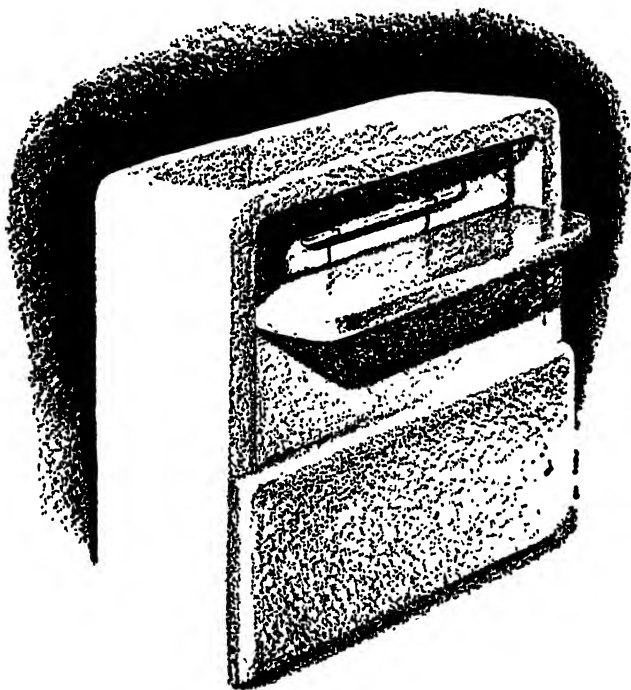


FIG. 9.

Must refrigerators be so deep from front to back? *Must* they have doors that swing open, thus adding to the space required in kitchen or pantry and allowing all the cold air to spill down towards the floor? Try rearranging the cubic space inside by flattening the whole thing against the wall. It would be wider, of course, but it wouldn't jut out into the room so far. Then try a sliding door, as in Fig. 9, one that moves up and down. It could be counterweighted, running in tracks at the side. To open it you would release a latch at the top and a segment of the door

would fold forward to a horizontal position, forming a shelf. You would slide this counterbalanced door down only as far as necessary to get at the item you have to remove, thus conserving all the stored-up coldness and cutting consumption of electrical current. If you needed ice cubes the trays would all be in a horizontal row at the top and cold-loss would be almost nil. The shelves would then be no deeper than a shallow cupboard, just deep enough, say, to take a turkey or a watermelon put in sideways. The cubic space would be the same, but the space would be more usable.

Or what about a round refrigerator? Why not put the evaporator tubes in a stack up the center and let the stack and shelves revolve, allowing each of four compartments to present itself in front of the door in turn?

Impossible? No. Impractical? Probably, at least for the present. A small concern might try one of these ideas and gamble all, win or lose, but the large companies have such big investments in tools and dies, as well as tradition to consider, that, even were these things practical, they might not be wise. Again I am simply trying to suggest the creative approach to a design problem.

WHAT IS A TEAKETTLE?

The same approach led one designer—a man at that—to revolutionize the design of teakettles. He analyzed the old style of kettle, which most manufacturers had for generations adhered to blindly, and in one stroke made them all obsolete. Why, he thought to himself, should the handle of a teakettle be made to hang down there where the heat comes up the sides to char the wood? Why should the handle twist sideways so that, when trying to pour out the last few drops, you swing the whole body of the utensil around and burn your hand? Why should the handle be in the center so that, in emptying it, the wrist is twisted into an awkward position? He answered these questions by fixing the bail permanently in an upright position, placing the handle off-center away from the spout, and molding the handle in a phenolic resin permanently to the bail. (See Plate 24.)

Another designer—again a man—went him one better. Why, he asked, should the kettle cover be removed at all, since boiling

water constantly sterilizes the interior and few women do more than remove scale occasionally? So he cast the kettle in aluminum, designed a handsome wood handle through one end of which a screw could be removed for occasional scaling, and made the spout large enough so that it could be filled through that opening (see Fig. 46c).

It was a designer, not an engineer or an inventor, who devised the first mechanical change in the operation and construction of sleds in 30 years (see Plate 32). It was a designer who found a way to eliminate the unsightly ventilating slots in the sides of the ordinary domestic wall thermostat.

Technological advances follow, one upon another, with such speed that it is impossible to prophesy very far in advance just what the products and machines of the future will look like. The design of airplanes has gone through whole centuries of evolution since the Wright brothers first maintained sustained flight for 59 seconds at Kittyhawk in 1903. Some new method of evaporation or some new fuel may make the refrigerator and the gas range, at least as we know them today, as extinct as the dodo in 20 years.

OTHER PRODUCTS

Without looking too far ahead, we might glance at other products and ask where the designer might make some creative contribution. Until the fuel for cars is greatly different from the liquid we use today, there will still be service stations and gasoline pumps. The modern pressure pump is twice as rapid as the old gravity style and it registers the amount of sale as well as the number of gallons. But when will the unsightly hose be put inside? When will we have multiple outlets from one remote pumping unit so that several cars can be served from each?

What about weighing scales in retail stores? When will they be combined with a cash register so that when the platter comes to rest the clerk can push a button that gives the price per pound, the total weight, and the amount of purchase on a ticket?

How would it be to arrange the keys of a typewriter in the form of a crescent? Then perhaps one bank of them could be eliminated, and still all could be readily reached by the fingers. This would be difficult, of course, with the present piano type of

mechanical type-bar action, but simple with a machine completely electrical.

Activity in the design field is becoming violently competitive and no sooner is a basically new idea put on the market than it is copied, with variations, in a hundred ways. With every mechanical change a whole new train of possibilities automatically springs into being, calling for new appearance approaches.

The amount of experiment and study the creative designer often puts into such a thing as the handle of a tire pump or the placing of a shift lever for a washing machine would astonish the layman to whom these parts may seem to be of minor importance. Good industrial design is not superficial. It must drill down to the bedrock of function, utility, and convenience if it is to be of real value to the client.

V · Design for Merchandising

MERCHANDISING is a good solid noun, centuries old, but its verb form, "to merchandise," is marked in English dictionaries as *archaic*. It took Americans, with their need for special words to express new ways of doing things, to revive it from its ancient slumber and put it back into currency.

Such a word was sorely needed in our commercial vocabulary. For merchandising is something more than mere selling. Selling is too often passive. Anybody can be an order-taker; any needed product, no matter how poorly made, will sell if the demand exceeds the supply. But merchandising is active. It takes imagination to be a merchandiser.

In other words, merchandising is selling plus. It is selling by means of putting yourself so completely in the customer's shoes that you can sell two where one was sold 'before. It is a new kind of selling, geared to the frantic scramble for markets. It was created by an economy of abundance, when potential supply is greater than actual demand, and vigorous measures have to be taken to assure sales.

Fundamentally, merchandising has nothing to do with high-pressure methods—brute force breaking down sales resistance with sheer lung power. Quite the contrary. It is the art of making things irresistible, of making the customer beg for them rather than part grudgingly with reluctant cash.

If a product sells well it is often because of some attractive gadget that has nothing to do with function. For half a century a certain manufacturer made coffee mills for retail stores. They were good coffee mills, but all they did was grind coffee. A few years ago the company decided that they would be doing their grocer-customers a favor, as well as selling more machines for themselves, if the mill could be made to *sell* coffee, too. They

turned the problem over to a designer, working in conjunction with a merchandising expert. They put the mechanism in a sheet-metal case with a window on the front; they placed a light behind the window and lettered upon it boldly, "Which grind?" This illuminated sign further informed Mrs. Citizen that the mill would grind coffee to suit *her* particular needs—vacuum pot, drip pot, percolator, or coarse cut.

Mrs. Citizen, intrigued by the novel appearance of the new service offered her, although commercial mills have performed this same service for years, would order a pound of coffee, "percolator-ground." The clerk would adjust a lever, a dial would spin, and while the coffee was grinding a colored picture of a percolator would appear behind the window.

Selling coffee is mere routine. But merchandising coffee adds zest and sparkle to the daily transaction. Result: more coffee sold to the customer, as well as more coffee mills for the client.

Such touches often swing a humdrum product into the best-seller class. Design for merchandising is an *additive* process. The man who first thought to equip a vacuum cleaner with a headlamp was a merchandiser. The man who put a cigarette lighter on an electric range was also using his merchandising wits. Radios have actually sold automobiles to prospects who would not otherwise buy a car.

Industrial design is the legitimate offspring of competition and aggressive merchandising. When the smart pioneer in his field offered the public a better looking electric iron or adding machine or deep-well pump or any of a hundred other products, competition was faced with the alternative of radical redesign or imminent decease.

Changing market conditions demand merchandising. Twenty years ago the problem in electrical refrigeration was to wean the buying public away from the old icebox. Today the *principle* of mechanical refrigeration does not have to be sold; rather, the job is to sell Refrigerator Y instead of Refrigerator X. How? The manufacturer of Refrigerator X promotes a humidified compartment with a plateglass cover. Manufacturer Y copies it and adds a water bottle with an outside spigot. Manufacturer X then engages designer Jones to streamline the exterior. Manufacturer Y

counters by retaining designer Smith to do a super-streamlined job, offering an illuminated control panel to boot. Marketing becomes a battle of merchandising wits, with engineer pitted against engineer and designer against designer.

A LIAISON OFFICER

The top-notch merchandiser and the outstanding engineer, due to temperament and training, are utterly different types of men. The merchandiser knows what the public wants but seldom has any idea of how to produce it. The engineer is interested in quality, performance, and costs, but his job is not sales. You cannot be expected to take the place of either of these specialists. You can, however, supplement them with your special brand of talent and sometimes act as a liaison officer between them.

Of course there is a great deal more to merchandising than just design and engineering. A complete merchandising plan embraces displays, dealer helps, sales bonuses, special trade-in allowances, methods of payment, service guarantees, and the entire gamut of sales promotional aids. Such a plan may involve special inducements, in the form of premiums, which have nothing to do with the appliance itself. We shall not, therefore, try to discuss the vast ramifications of modern merchandising. We are more interested in how, through design, we can help to entice a customer in and then make him open his pocketbook.

To the old-line manufacturer it may be heresy to state that today the shape, color, and appointments of a product are more important from a merchandising point of view than its mechanical features. The tardy recognition of appearance as an integral part of sales practices has apparently been due to the lack of an educated demand for attractive appearance in years past. The constant change and improvement in the modern automobile have done more than anything else to make the masses appearance-conscious. The yearly introduction of new models, calling for new styling, has been an impetus to manufacturers in other lines to introduce something new and different every year. Obsolescence has become an important factor in continuing sales. If a model can be outmoded by introduction of a newer design, more sales can be secured (see Chap. III, pp. 25-26).

THE CONSUMER'S DILEMMA

The consumer, unfortunately for him, has few facilities for checking the performance of one appliance against another. Consumer groups are making the public a bit more aware of performance, but some of the best selling appliances, when put to impartial tests, turn out to be the least efficient. They sell because of smart and gleaming appearance, plus appointments artfully calculated to add merchandising appeal.

Since creative design is such a potent factor in merchandising, it may be well to analyze ways and means of developing the merchandising slant on design. Deeply concerned as you are with engineering and production problems, with costs and with materials, you must know how to win popular acceptance. A merchandising sense is not necessarily a Heaven-sent gift, nor is it something to be afraid of. With reasonable intelligence and a willingness to try, you can learn to take the public pulse and find out how to flatter its whims and its fancies. But first you must know where to find the pulse.

In a sense the designer's contribution to any merchandising plan is synonymous with his creative contribution, discussed in the preceding chapter. However, by breaking down the marketing factors involved in a product enjoying national distribution, I believe we can suggest places for the student to look for information that will enable him to make concrete design contributions. Therefore, analyze the product in relation to these market trends:

1. The present market for all makes of the product.
 - a. Class of buyers: price ranges in relation to the income of potential purchasers.
 - b. Where the product is sold: department store, home-furnishing store, specialty shop, house to house, etc.
 - c. Sales distribution: rural or urban; regional or national; domestic, or export as well; the problem of freight differentials; percentage of saturation and the sales potentials (number of homes wired for electricity, for instance).

2. The client's own market.
 - a. Classes of buyers which competition does not reach.
 - b. Percentage of total sales in proportion to the rest of the industry.
3. Future trends.
 - a. Known developments to be introduced in the near future.
 - b. Research.

1. THE MARKET FOR ALL MAKES

General market trends require careful study. Although much will be learned from the client himself (see Chap. XIV), it is important for you to make observations of your own independently. Although you should not seem to be a meddler in established merchandising policies, you may, by keeping your eyes open, often suggest new approaches and, in a perfectly natural way, help to open up new markets.

a. Class of Buyers

Close study must be made of the class of buyers the product is intended to reach, because design treatment must be gauged with great accuracy to reach the biggest potential market. It would be difficult, for instance, to sell a Kentucky backwoodsman an electric washing machine, even granting he had power available. It is a fact that the largest and most elaborate radio sets do not go into the homes of the wealthiest people, but into the home of the factory worker. He may live in a shack but his radio and perhaps his automobile will be as expensive as he can afford—probably more so. Yet that same worker will buy the cheapest bargain-price washing machine, if he buys one at all. Designing a radio must take into consideration the ultimate purchaser and his buying tastes. The same is true of other types of market, too. A gasoline pump for the back-alley service garage need not have the same casing as one designed for the ultra-modern service

station, although the mechanism inside the two casings may be exactly the same.

Styling must take into account the *standards* of taste in the particular buying market the product is aimed at. Just as it is axiomatic in merchandising toys to put the product into the largest possible package, so it may sometimes be necessary to go "borax" on certain types of merchandise.

b. Where the Product Is Sold

A chromium coffee set sold through smartly appointed specialty shops, where each item gets a proper setting, can afford to be restrained and simple in treatment, with a dull or semimat finish. The same set, displayed in a crowded department store, where it must compete with many sets of other make, would be lost. Bolder treatment and a highly polished finish would make it stand out.

Appearance, whether in the form of line, shape, or even surface finish, has a definite effect upon the department store executive which is not to be overlooked. It may lead him, whether or not he knows just why, to empty out his whole bag of tricks in the promotion of the products you have designed. If your styling or some novel feature incorporated in your product appeals to his merchandising sense, he can do much towards making it a success.

For example, John Waxman is merchandise manager of housewares and home furnishings in a typical department store. There are several makes of cast-aluminum cooking utensils on the market, some styled and some not. The line which happens to appeal most to Mr. Waxman is a certain ware with a hammered finish. Other lines are more elaborate in design, but this particular ware is the only one that has this surface treatment. He selects it for promotion. The manufacturer cooperates with him by providing mats and newspaper advertising and foots the bill for half the newspaper space.

There is always a scramble for window display space among department heads in such stores, but Waxman wangles a week for his aluminum ware in one of the prominent windows on Main Street. The manufacturer supplies merchandising help in the form of backgrounds, cutouts, and other lithographed material.

Mr. Waxman supplements these with painted effects made by his own display department.

When the window display is ready, advertising breaks. On the fourth floor, Mr. Waxman has cleared the decks for his third focus of interest, an island counter right in front of the elevators with a glittering bank of aluminum utensils. He rigs up special spot lighting and has a demonstrator working at a handsome electric range.

The whole promotion lasts a week, for next week some other type of product must be pushed. Attractive surface finish was the merchandising theme that caused this particular merchandise manager to push this line of aluminum ware ahead of all others.

c. Sales Distribution

Still another influence on design is sales geography, although in recent years it has had less effect on styling than formerly. Appliances sold largely in rural and farm markets used to emphasize ruggedness at the expense of refinement; but with the rapid shifting of populations and the marked improvement in magazines reaching the farm home, rural and urban markets have been drawn much closer together.

Space is seldom at a premium on a farm, as it is in the city apartment. That may affect design substantially. Special small models of ranges, sinks, and dishwashers are required for city markets, but standard models can be offered in farm districts. Even metal burial vaults are affected by this rural-urban problem. In large cities such vaults have to be made especially narrow because cemetery space is at a premium.

The effect of regional markets on commercial equipment is also worthy of note. Makers of refrigerator display cases have to build special models for crowded cities where retail store frontage is narrow. These cases are built higher, rather than spread out in the horizontal plane. Their shape, in turn, influences the design of computing scales and meat slicers which must be made as compact as possible because of limited counter and shelf space.

If your client has a large export market for his products, you will find it has a marked effect on design. Everyone knows that the Englishman drives on the left-hand side of the road; hence automobiles sold in the English market have a right-hand drive.

Few persons realize, however, that because of the Englishman's keener interest in careful maintenance of his car, he expects lubrication and battery-charging equipment to be far more precise than Americans do. Service units in England are a mass of dials and gauges, carefully styled, although in most other fields England's progress in designing merchandise for appearance is far behind our own.

Products shipped for export knocked down, to avoid high freight charges, require special attention from the designer because they must often be reassembled at destination by unskilled labor. Refrigerators going to South America must be equipped with lock and key; thus breaker-strip design may be affected by a problem which we, in this country, never even meet.

If your client produces his entire output in one place and ships from that point, weight is serious. Selling his merchandise in distant cities, in competition with other manufacturers nearer the point of sale, will be difficult if not impossible because of freight burdens added to the sales price. Part of a designer's duties will be to investigate and recommend lighter materials. Toledo Scale Company not only reduced weight on one model from 165 to 57 pounds by redesigning in aluminum and plastics, but were also able to change from a wooden packing box to a corrugated container, thus reducing shipping weight and charges still further, to say nothing of the saving in materials. The over-all dimensions of a design may even be dictated from the start by the number of units that can be loaded in a boxcar or truck trailer. These things must be carefully studied before drawings or models are begun.

2. YOUR CLIENT'S OWN MARKET

Once you have studied the general market, turn your attention to your client's special market, analyzing the differences between it and competition. Perhaps his company makes the most expensive lawn mower on the market and is content to let others build "price" sellers. Or perhaps his mower is the quietest, and he trains his sales artillery on hospitals, sanatoriums, and large secluded estates. Far-fetched? Not at all. Many firms do a

handsome business by merchandising their products in some such special way.

The percentage of the total market your client supplies often affects the trend of design work, too. Perhaps he dominates the field so completely that he has no competition to fear. We were once called in to style a piece of special machinery. At our presentation meeting we showed three perspectives in color. The first was a moderate redesign, costing no more than the old machine; the second was a little more expensive to make but still within reason; the third was far too costly. We knew it, and showed it with reservations, expecting interest to center on the first and second. Nobody, however, would cast a single vote for any but number three. "What about cost?" we asked, somewhat dubiously. "It will add another 5 per cent." "Don't worry about that," our client told us. "We dominate the market so completely in this type of machine that we can write our own ticket!" Added appearance, it was explained, would justify the longer price. That, it must be admitted, is one case in a million.

In highly competitive fields, even if your client holds a commanding position in his industry, it does not necessarily follow that he will lead the parade in mechanical improvements or styling. The larger a company is, the less it may feel justified in introducing new ideas because of the big tool and die investment at stake. Often smaller companies, with less to lose in case of failure and more to gain in the event of success, will be bolder pioneers.

3. FUTURE TRENDS

The product development chief of one of America's largest firms is said to be able to forecast the acceptance of a given piece of merchandise with such uncanny accuracy that subsequent sales records bear out his predictions within a few per cent. He is not a designer or even an engineer. He was trained, strange to relate, in the school of abstract speculation, for he occupied a university chair of philosophy before going into business.

Prophecy, however, is a risky business for the person without his remarkable powers of analysis and the vast fund of information at his command. A few failures and your reputation is gone. Designers cannot hope to match a performance like that and

they should not be expected to. The good designer is an enthusiast, a creator, and the creative impulse is not always compatible with such keen and calculating evaluation. To be a good creator a designer must, however, keep his ears cocked for new trends about to be announced, seizing themes that seem valid, discarding mere fads.

Everyone knows that rear-engined automobiles are in the wind. Such cars are fairly common in Europe and a few have taken to the road in this country. But, although designers and engineers were dreaming about them in the '20's, they are not here yet because, with much in their favor, there are still many difficulties to overcome.

Public acceptance is slow to form; mass education is necessary first. Refrigerators have gradually, almost imperceptibly, been getting shallower and wider. Will they, one day, go the whole hog and be flattened against the wall? There is much grumbling about the low-oven range. When will the psychological moment arrive to re-introduce a range with the oven at more convenient height? Console radios used to have legs; then for several years they were skirted down to the floor and the leg models looked as old-fashioned as grandma's rocker. But suddenly legs came back and a few companies, clever enough to foresee the trend, made a killing. Judging public taste is almost as difficult as accounting for the length of women's skirts. Taste goes in cycles. To anticipate the return of a style is as valuable a contribution as to create a new one.

Air conditioning, a rapidly expanding field of exploitation, is in such a fluid state that it might be unwise to design such units for too great permanency. A big investment in dies might be uneconomical in the face of radical innovations which may force the entire industry in another direction in a year's time. Therefore, it would behoove the designer to counsel his client against expensive stampings and show him that much can be done at reasonable cost with fabricated sheet-metal housings.

Study every phase of the industries you serve with a view to anticipating trends wherever possible. Obtain catalogues and folders showing how competitive products are designed. Check especially the specification sheets and technical data. Observe what features competition stresses. They may give you a clue to

trends in the industry which you can use to your client's advantage.

Keep in close touch, wherever you can, with research. Scan the technical magazines and trade journals for future developments. From research laboratories often come not only new products and processes but entirely new industries. Ten years ago Goodyear little thought they would be in the mattress and seat-cushion business, until, in their experimental laboratories, Airfoam was discovered. Union Carbide had no idea they would be making most of the linings for beer barrels until their chemists developed Vinylite. Du Pont and many others are constantly introducing new plastics, most of which will soon find special uses in industry.

Merchandising is of prime importance. On merchandising depends the success or failure of the products you design. You cannot afford to leave a single stone unturned in your search for salient features that will make your design produce more sales. On sales depends your future.

VI · The Practical Side

IF BUSINESS knew just what to expect of designers and designers were all trained to the point where there would be no question about their competency to deal with production problems as well as with artistic problems, this chapter would not have to be written at all. Their reciprocal relations would be accepted as a matter of course and the manufacturer would merely be faced with choosing the man he felt most competent to create new merchandise for him.

But in the infancy of industrial design, which was not so many years ago, a great hue and cry arose to the effect that all designers were long-haired visionaries. They were bitterly resented by some engineers and by most production men. "It's all very well to draw pretty pictures," they would say. "But what's the good of that if you can't make 'em?"

In some cases the criticism was justified, and occasionally is today. Nor was the cause of better looking merchandise advanced by the cavalier attitude of some designers who would declare, "That's what it should look like; now it's your problem to build it." Complaints about such tactics are not so often heard now, for designers by and large are getting to know the processes of manufacture more intimately. Financial conditions, too, have made them acutely aware of costs.

Before trying to define the boundaries of the practical knowledge any good industrial designer should have, let us ask just what is meant by "practical." Webster defines it thus: "Of, pertaining to, or manifested in, practice or action;—opposed to *theoretical, ideal, speculative.*"

Of course we all admire the do-er, the man of action. When we say that Jones is a practical shopman, we mean that we can count on him to keep the wheels turning, eliminate duplication

of effort, reduce costs. But do we mean that we look to him to create something brand-new?

A "practical" inventor is one who takes the discoveries of other more visionary scientists, and puts them to definite industrial or commercial use; but the really momentous advances in science and invention have been made by the visionaries. Franklin's kite and Newton's apple were the butt of every jokesmith in their day. Galileo, da Vinci, Pasteur—even Edison, archetype of the practical inventor—were called foolish or misguided or just plain mad. It is easy to recognize the importance of the telescope and the incandescent lamp now that they are accomplished facts, but not so easy before.

There is really no fundamental incompatibility between art and practicality. "From the beginning of time the artist has been practical," say the authors of *Consumer Engineering*.* "He has made things with his hands and made them well. He was singled out because he also made them beautiful and attractive, but always and everywhere he was a craftsman, a maker of objects. He merges with the inventor on the one hand and the workaday artisan on the other. His imagination keeps him from thinking only in terms of what we already have. It enables him to understand the mechanical without being dominated by it . . . "

THE FRESH EYE

Has it ever occurred to you that "practical" is a relative word? What was practical in grandfather's day is so hopelessly old-fashioned now that it has become highly impractical for our more exacting uses. The hand churn was once such a device and is still in use in remote localities, but for efficiency it leaves much to be desired. The DeWitt Clinton was a practical locomotive a century ago, today a museum piece.

The analogy with industrial design should be obvious. The designer need be only relatively a practical man. The manufacturer usually calls him in because he is frankly stumped. He is surrounded by practical men—his engineers, his production chief, his draftsmen—but they seem to proffer nothing new. Does

* *Consumer Engineering*. By Roy Sheldon and Egmont Arens. Harper & Brothers, New York, 1932.

he, then, expect the designer to be as practical as they? I doubt it. He longs for a fresh eye. He hopes that this outsider will be able to make one of those leaps in the dark that his own men, perhaps just because they are so practical, dare not make.

In the early days the designer who was soliciting, let us say, a furnace account, was asked, "Have you ever designed furnaces before? No? Then how can you expect to design furnaces for us?" In vain he would try to convince his prospective client that the principles of design are the same whether applied to furnaces or automobiles or office furniture. A little reflection would have told the manufacturer that it is obviously impossible for any free-lance designer to know all the ins and outs of the furnace business as well as he. But it is just that workaday knowledge and market experience that the designer does *not* need; on the other hand, he has a specialized knowledge and talent that the manufacturer lacks.

The purpose of this volume is not, however, to minimize the importance of the practical side of industrial design. On the contrary some will find this book too practical, too engrossed in the business of giving the client—and the public—what it wants. Its aim is precisely that and nothing more. The acid test of design is *Will it sell?* Abstract beauty is well enough, but educating the public is an expensive pastime—one that business can ill afford in these days of bitter competition.

As a designer you must strike a middle course. You must give the public the very best it will absorb, and not one bit more. But you must also avoid the pitfall of underestimating the public's taste, which is far better than most of us believe.

THE TEST OF A PRACTICAL DESIGN

Our problem, then, is to analyze the body of practical knowledge that goes to make up a successful piece of merchandise, and then examine what part of that knowledge you should possess. Any product or machine intended for sale must be practical as to: (1) its use by the consumer, (2) its process of manufacture, (3) its cost.

1. *Practical As to Use*

In the beginning, concentrate on the usefulness of the product almost to the exclusion of production and cost. Are you styling

a vacuum sweeper? Very well then, ask yourself questions like this: Is the handle the right length for the average woman? Is the grip at the correct angle and shaped comfortably for a woman's hand? Is the switch convenient to operate? And what about the center of gravity when she carries it from room to room?

Or perhaps it is a tool grinder you are about to design. Is the wheel at the right height, and have you given the operator enough toe room so that he can stand close to the work? Is the glazed opening in the safety shield large enough so that both tall and short men can see clearly what they are doing? Is the control panel arranged so that they can reach the safety-stop button in the twinkling of an eye?

These are the things you must consider first, long before you choose the color for the fabric of the dust bag, or round off the corners of the worktable castings. But, if you allow your initial approach to be blocked by an impenetrable wall of "don'ts" from production men and cost accountants, the results of your labors may be only a meager modification of the original product—not much better than the client's own staff could produce unaided.

There is a small room humidifier on the market, designed well for appearance, which does an excellent job for its price. But the water pan is shallow, and when filled, the device cannot be carried from room to room without spilling, a defect that could have been obviated by welding in a few vertical baffles. One of the best looking sets of lavatory hardware on the market is so designed that it is twice as hard to turn the water on and off as with the ordinary type; and, as the washers wear down with use, the faucet handles do not "line up." Neither of these designs is practical *as to use*. To repeat, your job as designer is synonymous with making useful products more useful still, beauty clinging to them as you proceed almost by a process of accretion, like electrolytic deposits of metal in a plating tank.

In the really creative piece of design it is curious how often talented designers without previous experience in a certain type of manufacture have hit upon some flaw in operation, some fault in convenience, which had completely escaped the client and even the vast consuming public. Score one for the fresh eye. But it is manifestly impossible for the outsider always to visualize, or himself deduce, even after operating the equipment himself, all

of the practical faults in the usefulness of any product. The only way to know the whole story is to accept the verdict of mass experience, to weigh one criticism against another, and to separate the whole grains of constructive criticism from the chaff of cranks and soreheads.

Therefore the wise designer supplements his own observations with every scrap of information he can obtain from the manufacturer. He consults the sales manager, the service men, and the salesmen in the field. He talks with retail merchants and demonstrators to unearth every suggestion that may help him create something more useful to the purchaser (see Chap. XIV).

No matter how practical your work may be as to manufacture and cost, your job is only half done if you cannot make some creative contribution to the product's usefulness in the hands of the consumer.

2. Practical As to Manufacture

In the production phases of manufacturing you will meet your most severe challenge. You have conceived a handsome product. It is admittedly better looking than its predecessor. But can it be built? A challenge, perhaps, but it should be considered rather as a stimulus to your ingenuity, because the ideal design should be one that is not only better looking, but can be manufactured as simply, and at about the same price as its predecessor—or less.

The question is, how much of the practical knowledge necessary to manufacture it simply and cheaply must you possess in advance? When design and manufacture went hand in hand, before the days of our modern engineered products, the designer was almost invariably a practical man. The early textile designers often wove the fabrics themselves, and knew intimately the processes of printing and dyeing. Furniture designers lived in the drafting room and the shop. They were all specialists and all practical.

Can today's designer to industry know all the technical processes of modern manufacture as intimately? Must you know just when to rap a sand mold and how to set a core? Must you have the specialist's intimate knowledge of stamping and plastic molding and sheet-metal fabrication and forging? Must you know

how to set up work in planers, milling machines, and drill presses, then work out the jigs and fixtures?

Obviously impossible. You must, however, "know your way around." You must know which of these processes is applicable to the product you are trying to create. For example, if a sand casting for a compressor requires a finished surface, you must know how much finish pad will be required and whether the part will be disk-ground or milled. If you have designed an aluminum coffee percolator, you must know whether it will be made on stamping presses or spinning lathes, or both. If spot welding is indicated on an oil-burner housing of your creation, you must design the part so that the electrodes of the welder can reach the point where the contact is to be made. If a plastic radio cabinet is in question, you must know enough to avoid undercuts, where to place ribs or bosses for metal inserts, and when to add curvature to give strength and minimize warp.

In other words, you must understand the limitations of many processes, but you cannot and need not be a specialist in all. Throughout the development of your design you should lean heavily on the engineer and the shopman, specialists in that particular field. Designer and factory men should—in fact they must—learn to work together toward a common end.

"Limitations" should never become a bugbear. Every problem is hedged around with limitations. They discipline the creative designer, stimulate ingenuity, spur originality. The successful designer is the one who can come through with flying colors in spite of restrictions.

It may be of some encouragement to the student to realize that engineers of undoubted reputation and ability in their special lines are sometimes woefully ignorant of common manufacturing processes which do not happen to touch their field. A practical plastic-molding man might quickly find himself in hot water if asked to pass on the practicability of a metal-stamping operation.

Methods change so rapidly that what may have been impractical today is commonplace tomorrow. There is a flexibility in stamping operations today which was unheard of in the '20's, and much of this progress has been the result of the "unreasonable" demands of designers, especially in the automobile field.

By their insistence on the production of certain difficult shapes, they have forced metallurgists, engineers, and tool designers to do the seemingly impossible.

Not long ago I overheard the chief body engineer of one of the independent motor companies talking to the head designer. When the designer expressed doubt whether or not a certain fender shape could be made, the engineer said, "You show us how you want it and we'll find a way to build it."

A far cry from the timidity of the production man of old!

It is not uncommon even for experts to disagree about the feasibility of a given design. One of the most striking instances I know came to light while we were styling a domestic conversion burner. Our design called for a stamped metal end-cap to cover the regulator and valves. A full-size dummy model was built and approved by the management. We made our dimensioned layout, which in turn was converted by the client into shop drawings. Prints were sent to three large stamping companies for estimate.

The contract was finally awarded. The stamping firm obtaining the order built dies and began to attempt the production of sample pieces. In every case the sheet steel either tore or wrinkled. We were then called in and worked out changes in radii and fillets at certain points to relieve the strain on the metal. The dies were modified accordingly. Still no luck.

The supplier then suggested radical changes in the design which neither we nor our client would approve because they completely altered the desired appearance. After spending several thousand dollars in dies he finally gave it up and the piece went to a die casting. Yet none of the firms bidding on the business had expressed the slightest doubt at any time that the design as shown in the blueprints was difficult to draw in the proper steel.

In such a case, would it be fair to call the designer impractical? We were willing to make modifications in our drawings up to the point where they did not completely destroy appearance. We even offered to recast the design entirely but the management by that time were completely sold on the appearance, and were willing to spend more for a die casting to obtain it. The final cost of the completely assembled burner turned out to be about the same as the burner it replaced, even in spite of the increased cost

of the cap. Furthermore, it produced a sales increase of 55 per cent in seven months.

Is there danger of the designer's becoming too practical, of finding himself, like some production men, "so close to the trees that he can't see the woods?" Frankly, I believe there is. The manufacturer, as I have said, calls upon him because he wants a fresh eye. If he works in one industry for a number of years, being only human he may become too engrossed in manufacturing problems, too much hampered by the "don'ts" of that particular industry. It may become as difficult for him to create new merchandise as for others in the same company.

A conscious effort to tear his mind away from too strictly practical considerations may help him to strike out boldly again to new conceptions. But the best tonic for the jaded imagination is to acquire other accounts in fields of manufacture as different as possible in character. Designers who serve a varied clientele find that their experience in one field greatly improves their work in others.

3. *Practical As to Cost*

Cost, as you soon learn, is the touchstone of a product's success. There may be occasional instances where, due to novelty or to some rock-ribbed patent structure, cost does not loom large. But most design projects reduce themselves automatically to a battle for pennies from start to finish.

There are occasional instances where increased cost is justified. If you contribute new and radically improved features, of such importance that the product is put in a class by itself, a price increase might be possible. But in most highly competitive products, the American public is accustomed to annual or biennial models, and they have come to expect added features at a price comparable with the earlier equipment—and lower if they can get it.

A new design of radically improved quality has often resulted from a program begun merely with a view to improving a standard product. In such cases the new design might conceivably be placed on the market as a de luxe number, retaining the standard item at the same or at a somewhat reduced price. Such

tactics frequently result in opening an entirely new class of sales, stimulating the standard product as well.

After your first creative work is done and your first visualizations discussed with executives, costs should be constantly in your thoughts. You should insist on cost estimates being made before the work has progressed too far. Sometimes a manufacturer is so carried away with your idea that he himself will wait until full-size models are built before taking the matter of cost too seriously, only to suffer a rude awakening by the time a thorough analysis is made.

Here again experience is your only real teacher. Gradually you learn to discard your most extravagant dreams automatically. You must be wary, however, of accepting the snap judgment of some draftsman or production man that cost would be too high if built according to sketch. Thus you might discard a design which, if gone over carefully with conscientious effort to work out the simplest possible construction, might prove to be quite practicable.

We once designed a piece of commercial equipment which the production staff said would be entirely out of line in cost. Backed up by the president, who was enthusiastic about our small model, we pushed it through to the point of detailed drawings and final cost estimates. The design, created four years ago, is still on the market and production costs are less than the model it replaced.

Every industrial designer worthy of the name will abide by cost limitations, when proved valid. He must be ingenious enough, however, to suggest ways and means of achieving the desired appearance if at all possible within those limitations.

VII · The Fee Question

DETERMINATION of fees is a puzzling and ticklish problem. If the designer is worthy of his hire, just how much is he worth?

There is not now, and perhaps there never can be, any standard method for setting fees that will fit all cases. The architect who designs a house charges his 6 to 10 per cent, but he knows in advance approximately how much he is going to get for his services, because the client has told him how much he wants to spend. The advertising agency gets its 15 per cent of space and production costs. Both of these professions have background and tradition.

Industrial design is not old enough to have traditions. Established designers are closemouthed about their fees, and rightly so, for it is a private matter between designer and client. A few attempts have been made by industrial designers to work out standard practices, but their efforts have come to nothing.

A few huge fees have been paid in the past which were unjustified, perhaps, by the results obtained. In the beginning, someone was bound to fall victim to smart salesmanship and glowing ballyhoo. A prospect once said to me, "Why, I thought you chaps never touched pencil to paper for less than fifty thousand!"

By and large, however, successful designers must be charging reasonably for their services, or they would not still be in business. "Reasonably," it should be noted, means in reasonable proportion to other productive expenditures like advertising and tools, and (if it is a "repeat" order from the same client) in proportion to results obtained from former designs.

The common talk about fancy fees is largely the result of unwise publicity plus the natural American tendency to exag-

gerate, especially in money matters. President Williams of the John Doe Company lets slip the remark that he paid designer Smith so much to style such and such a product for him. As word passes from mouth to mouth, the figure may reach fantastic proportions.

Occasionally in talking with a competitor a manufacturer will raise the ante intentionally just to frighten him out. Word once came back to us, through devious paths, that a certain product we had designed cost our client an immense sum. In that particular case a fraction of the amount would have been nearer the truth. Such pointless exaggeration has given industrial design the reputation in some quarters of being little better than a refined artistic racket.

There is never any publicity, of course, when the client gets more than he paid for. Several years ago we undertook the modernization of a product at a modest figure, completed the work in four months, and made a reasonable profit. That particular product is still on the market and many millions of dollars' worth has been sold. Expressed in percentage of the manufacturer's sales price, our fee represented one-thirtieth of 1 per cent of sales for the first year only.

Too little—considering the marked effect of the design on sales? Perhaps. Were we underpaid? Not at all. We made our profit. Had we been able to foresee this phenomenal sale, we might have quoted, and surely obtained, more. However, when we designed that first model, the firm was just being reorganized after bankruptcy, and if we had quoted more, we would not have got the job at all.

We are still designing for that company, and our fees are naturally higher. We have proved our ability to create fast-selling merchandise, but at that time they were willing to gamble just so much on our ability to improve their products. It so happened that they won. So did we. Hence there can be no regrets.

EVALUATION OF DESIGN RESULTS

Even after a newly styled product has been put on the market and has proved a success, it is somewhat difficult to disentangle with any degree of accuracy the precise factors that have made it

successful. Frequently some new mechanical feature has been added which brings about marked improvement in performance. Some mere gadget, because of its novelty, may turn the trick. The advertising budget may have been doubled compared with previous years, or new marketing policies may have been adopted which will account in part for increased sales.

Failure, too, may be due to depressed general conditions, to misdirected promotional activities, or to lack of sales initiative, rather than to any defect inherent in the design. None of these factors makes it easier to evaluate the role played by appeal to the eye.

Design fees naturally vary with the type of product. One of the major electric refrigerator companies may sell a quarter of a million units per year at an average price of \$200. The tool and die investment alone will approach \$1,000,000. It is naturally worth while to pay a handsome fee in order to be sure they have the last word in appearance. You may work just as hard on a piece of machinery that sells for \$10,000, but perhaps only 50 units will be built in a year. Obviously your fee cannot be the same in both cases. It is then your personal problem whether you will wait for larger fees providing longer profits, or keep yourself and your organization busy by handling a number of smaller jobs.

In the above comparison, the refrigerator enjoys annual sales amounting to \$50,000,000; the piece of machinery only \$500,000. However, the relative disparity in fees should not be so great as would seem to be indicated. In the highly competitive home appliance field, where a general standard of prices prevails, every penny of cost counts heavily. A big design fee, even though only a small fraction of other expenses (development, tools, promotion) might loom large when distributed to each individual unit.

With a piece of machinery selling for \$10,000, sales cost and distribution are proportionately only a fraction of similar costs in consumer merchandise, although general engineering and development expenses are relatively much higher. Margins in durable goods need not be so close, because, in building a highly specialized machine, competition is not such a factor in making the eventual sale. Hence your appearance-design fee on machinery

might logically represent a larger percentage of the actual sales price.

WHERE SHALL WE CHARGE IT?

“Where shall we charge design expense?”

At some time or other this question always arises in executive councils. If designing for appearance is new to the company, it is unlikely that any provision has been made for it in the budget. Then where will they get the money? Perhaps they have set aside a fund for such contingencies, perhaps not. If not, the usual battle is waged to determine where pruning will have to be done to meet this extra-budgetary expense.

If the design fee is dropped into the lap of Development Engineering, the head of that department, with his operating budget to consider, naturally resents it. The sales chief probably wants design assistance badly, but he too is nursing a budget. The whole question becomes an intramural football match, delaying decisions and often creating ill will. The poor designer is caught in the scrimmage and perhaps undertakes the work at a bare break-even fee. Then it is hard to do a decent job.

A prominent designer has suggested that fees be made a factor of tool expense by setting some percentage relationship between the fee and the cost of the tooling program. That would be a ticklish precedent to set, however, for so much depends on the type of product and its volume of sales. Then, too, one product may have an assured volume-expectancy, whereas another may be highly speculative.

By whatever means the amount of the fee is finally determined, however, the most sensible place to charge it off is along with tools and dies, amortizing it over a predetermined period. This is far more intelligent than attempting to saddle any particular department with the expense.

METHODS OF PAYMENT

It would be difficult to conduct a design office strictly on one set fee basis. Policies governing such matters vary widely in different companies. To some firms, royalties are anathema; others consider them quite logical. Some concerns are accustomed to paying for special services on a retainer-fee basis; others insist

upon knowing the exact cost, or at least the maximum cost, in advance. The merits and drawbacks of various methods of payment are therefore worth discussing in some detail.

There are a number of ways in which you may charge for your services:

1. Straight project or per-job basis.
2. Retainer fee.
3. Retainer fee, plus other charges at cost.
4. Royalty.
5. Cost plus.
6. Consultation fee.

1. *Project Basis*

In designing a single product or a related line of products, this method will best suit your client in nine cases out of ten. With a definite quotation before him, he knows just where he stands. Consulting his past sales figures and estimating his anticipated volume of business in the future, he can tell approximately how much the design work will add to unit cost; unless, as frequently happens, you can save him money, in which event there would of course be no argument about fees. But no one can guarantee such results in advance.

But what about you, the designer? Your work is creative, and as such will obey no fixed laws. How long does it take to get an idea? Is there any rule to cover that? In quoting on the project basis, you are faced with the problem of setting a definite fee for work which has not yet been started, the completion time of which may be extremely difficult for you to estimate, and the value of which will not be proved to the client until it meets the acid test of sales. It is small wonder that you find it difficult, and that designers' fees vary so widely.

If you can afford to name a take-it-or-leave-it price which you are sure will cover all of your time and expense even in the most unexpected contingencies, you are fortunate. But it is presumed that you want the prospect's business and the prospect needs

your services. Therefore you must quote a figure which he will accept, yet which is large enough to assure a profit for yourself.

It takes some years of experience to estimate these project-basis jobs successfully. It can sometimes be done by analogy with jobs of a similar sort handled in the past. Cost sheets* will give you the profit or loss figures on former jobs, and you make your estimate with these in mind. Usually, too, the prospect will be reasonable enough to recognize the difficulties involved in estimating with exactness, and permit you to make a quotation within minimum and maximum limits, with a differential of perhaps 15 or 20 per cent. You are then in duty bound, if the job has proved simpler than you anticipated, to figure your actual cost, plus overhead, plus normal profit, and to submit your final invoices accordingly.

In quoting by the job, you estimate roughly in advance the time for completion of the work—three months, six months—whatever it may be. Frequently, however, through no fault of yours, there are long delays. If you receive payment only on completion, you may have to wait a long time for your money. Therefore it is only sensible to agree in advance on partial payments to be made upon completion of certain stages of the work.

The procedure of industrial design falls quite logically into three stages; (1) preliminary visualizations, (2) models and/or finished renderings, (3) dimensioned drawings. Since the first stage is by all odds the most involved (gathering data, studying the field, and doing the actual creative design), the largest share of your fee should be paid then, at least 60 per cent. The balance can be paid in two equal installments upon completion of the presentation model and submission of the final mechanical drawings.

This parallels the arrangement made with most architects, who receive part of the fee for plans and perspective sketches, another installment upon completion of detailed drawings and specifications, and the balance when supervision of construction is completed.

If you undertake work on a predetermined fee basis, you must be prepared to see it through to production. Perhaps all has gone well until the final stage of full-size mock-ups, and then your

* See Chap. XXVI.

client finds that the design will not do. In that case you must start over again and keep at it until you have satisfied him. If, however, rejection of the final model is due to some change of policy within the company, or some upset in market conditions beyond your control, you have a right to ask for further payment to cover additional effort.

2. *Retainer Fee*

In household appliances, juvenile wheel goods, domestic heating, service station equipment, metal furniture, and many other lines, new models must be offered every year or two. Such companies usually prefer the retainer fee method of paying for design service. To them, design is an everpresent problem, and, if they do not maintain a design department of their own, they at least recognize appearance as a constant factor and make allowance for it in their budgets.

In such cases the problem is merely to arrive at a mutually satisfactory monthly fee. With annual accounts there are usually peaks and valleys of activity. You break even or lose money for one or more months of the year, then make it up later. It is unwise, either from the manufacturer's point of view or your own, to sign up for a long time on a regular retainer fee until a trial period of three to six months, falling equally between the heavy and the light seasons, has been experienced. Then you know something about your cost of handling that particular account, and adjustment up or down may be in order.

A protracted program of modernization in the heavy industries field, machine tools or farm machinery for instance, might also be undertaken on retainer fee. It goes without saying that the manufacturer who retains you for any length of time must be thoroughly convinced of your competency and sure that you will be conscientious in your devotion to his problems.

3. *Retainer Fee Plus Other Charges*

Perhaps the most satisfactory of all methods of paying for industrial design service is a combination of a retainer fee plus other charges billed at cost. The retainer-fee part of the charges covers all the time of the chief designer or partners (or the chief designer and an account executive as the case may be), plus *all*

profit. In this retainer fee the manufacturer is paying not only for the time of the most expert members of the organization, but also for that most intangible and valuable of all commodities it has to offer: their talent and experience. Depending on the magnitude of the problem and the size of the fee, the designers allocate to that account a certain proportion of their time, varying perhaps from month to month but maintaining a certain average. Then the more routine phases of the work, such as rendering, drafting, and model-building, and other expenses such as out-of-pocket travel, telephone and telegraph, special materials, blueprinting, etc., are billed at actual cost.

Thus the manufacturer pays for mechanical services exactly in proportion to his demands. You are protected in case these demands become unusually heavy, for they cannot cancel out your profit. The difficulties of estimating a job in advance are minimized and the work continues only as long as necessary for proper completion.

If a standard fee system is ever agreed upon among industrial designers, it will probably be somewhat along these lines. With a little experience in handling accounts this way, you will be able to estimate within reasonable limits what amount of routine service, at cost, will be required, and about the number of months necessary to finish the work. The client then has a quotation tantamount to one figured on a project basis; yet you are safeguarded against unforeseen delays and extra work due to sudden "changes of pace" on the part of your client.

4. *Royalty*

From the designer's point of view, working on royalty is alluring at first glance. If a prospective client favors the idea at all, it will not be hard to get the signal to go ahead. The manufacturer puts up nothing, save perhaps a little time to get you started and to look at the drawings when they are completed. And you, full of confidence in your ability, stand to clean up—if you can make a ten-strike.

As in any gambling game, even an "honest" one, the odds are somewhat against winning. Straight royalty is little better than pure speculation—we shall speak later with feeling about speculation. Even with the best will in the world, the manufacturer who

gets something for nothing is inclined to be hypercritical; whereas, if he already had an investment in the designs, he would be more inclined to follow that investment up with further expenditures to get them in production.

The hazards are almost too great. Market requirements suddenly change and months of work will go for nothing. There is one case of a designer who had an entire line of glassware ready for molds when a change in the Central European situation knocked the whole program into a cocked hat.

If you insist on taking work on royalty, certain supplementary arrangements can sometimes be made to provide you with a margin of safety. The percentage of royalty may be reduced and a cash amount paid on presentation of the preliminary sketches, an amount perhaps just enough to cover your cost up to that stage. The client then has a small stake in the design and is likely to take it more seriously, whereas you get at least something out of the transaction even if your designs never get on the market.

Beware of the "limited" royalty. Occasionally a royalty on all sales "for the first year" will be proposed. If you are going to gamble, better gamble all or nothing, and be sure that your royalty is paid throughout the life of the product. The suggestion is even made of a royalty to be paid until a certain total is reached, then discontinued. That is the equivalent of saying that the design is probably worth so much, that the manufacturer doesn't want to pay anything to have a look, and that, even if he takes it, he is going to be sure of his own cash in the till. You should have no part in such an arrangement.

Although simple agreements made by letter, with an "Accepted . . ." line at the bottom, will suffice as a contract with any reputable concern when working on retainer fee or by the job, if you undertake work on royalty be sure to have a formal contract. The provisions of such a contract should be worded with the greatest care. Before signing any royalty agreement it would be well to consult some work like Wright's *Inventions and Patents*.*

Royalty arrangements will, in general, be met with infrequently. Few companies with large production of an established

* *Inventions and Patents*. By Milton Wright. 2d ed., McGraw-Hill Book Company, Inc., New York. Chap. XIX gives 33 rules for royalty contracts.

item will be interested in paying a royalty for appearance design. Most firms have many other royalties to pay for inventions and bookkeeping problems become highly complicated. The royalty is applicable rather to the novelty item, which in itself is speculative.

5. *Cost Plus*

This is probably the least frequent basis of payment. It will be satisfactory to both parties only if they have worked together long and amicably. For you, of course, it is ideal. You cannot lose due to incorrect estimates of time.

How much the "plus" will be—in other words, how much you feel will be a reasonable profit on your operations—is for you to establish. It cannot, of course, be figured like the margin of profit on merchandise. A service organization is not a factory. Its employees cannot very well be laid off and then rehired when needed. Its percentage of idle or unchargeable time may vary considerably. In fact, its entire operations are speculative in themselves and more subject to feast and famine than manufacturing, even in troubled times. Therefore your margin of profit, over and above actual cost of time, materials, and overhead, will naturally have to be greater than would be normal for soap, or shoes, or sofas.

Determine for yourself what constitutes a reasonable profit, then stick to it in figuring gains or losses in all transactions, whether based on retainer fee, royalty, project, or cost plus.

All accounts, no matter what the fee basis, should be quoted plus out-of-pocket travel expense. If an out-of-town client desires frequent contact calls, he should expect to meet these expenses as incurred.

6. *Consultation Fee*

When a manufacturer seeks a consultant, whether technical, legal, or artistic, he chooses him because of reputation and wide experience. Perhaps his firm has its own design staff, and merely wishes a checkup by an expert with a fresh eye and an impartial point of view. Sometimes it is worth the money merely to be told he is right.

The size of consultation fees, whether paid per diem or on some annual basis, is entirely dependent upon your ability and upon how much the company needs your advice. Some designers ask, and get, handsome sums for a few days of their time. It is obvious, then, that the consultation basis is not for the beginner.

SHALL I SPECULATE?

"We shall be only too happy to consider any ideas you may care to submit."

In soliciting new business, every designer has heard this remark a thousand times. If you are wise, you will turn a polite but deaf ear to such suggestions. No reputable designer submits sketches on approval. The established manufacturer does not expect the best legal counsel or other professionals to advise him, and then pay for their services only if he accepts the advice.

The whole question is faintly reminiscent of Mark Twain's famous reply to the autograph seeker who asked him to sign his name and throw in some original sentiment for good measure. "What! Would you ask a doctor to give you one of his corpses?"

Everyone who has tried to sell intangibles is acutely aware of the fact that the prospect is facing a genuine gamble. However, the businessman must realize that the designer's stock in trade is ideas, plus specialized knowledge and training. By the time an idea is ready to be presented to the client, the creative job—the hardest part—has already been done. In ninety-nine cases out of a hundred, he cannot sell it to somebody else, for it has been designed especially for one concern.

Speculative work has become the bane of the advertising business and it is to be hoped, as industrial design develops into an established profession with a code of ethics and some tradition, that speculative design will not be a part of its background.

If you are a beginner, these may seem harsh words, calculated to close the door in your face. "How am I to acquire a reputation," you ask, "until I have some concrete accomplishments to show?" The answer is, you will never acquire a reputation at all if you speculate. Better starve waiting for orders, than starve submitting sketches on approval. It is impossible to do a good design job without getting close enough to the inside to understand the problem thoroughly, and you will never get on the inside if you

crawl there on hands and knees. Your prospect has committed himself to nothing, and he will attach no value to your designs because he has not paid for them.

Get paid for your work from the beginning, *no matter how little*. One of the most successful designers in the country says that he has been drawing either for publication or for manufacture since he was thirteen years old, and has never made a drawing yet for which he was not paid at least something.

Industrial design, if properly done, is not cheap. Neither is advertising. The primary objective of both is to build sales, to increase profits. Anything that accomplishes that purpose is worth paying for, and paying for well. If creative thinking, a knowledge of manufacturing methods, and a sympathetic approach to production problems are expected of the designer, design bargains are poor economy.

If this book succeeds only in convincing the skeptical that the industrial designer has a serious contribution to make, and one that is worth spending money for, it will have been worth writing.

VIII · What Future?

THIS CHAPTER will attempt to answer two questions: What is the future of industrial design? And, if you choose it as your vocation, what future may you look forward to?

Naturally, if there is no future for the profession, there will be none for you as an individual. And if there is a future for you, you will want to know what kind of training you should have and where to get it; where you can expect to find a job; and, when you get one, what kind of financial return you may hope for.

Industrial design as described in this book is so new that it is both difficult and dangerous to make prophecies. Any forecasts ventured here will be largely personal opinion. Surveying the field, however, from as broad a standpoint as one individual can, it seems to me that the surface has scarcely been scratched. It stands to reason that a profession which has made such astonishing strides in little more than a decade, is bound to have a tremendous future. Appearance has already proved itself such a valuable tool in merchandising that, from the very nature of things, it must gain momentum as time goes on.

Then, too, many concerns have never tasted the sweets of successful design for sales. Some, attempting to supply the missing link themselves without professional help, have done it so timidly that its effects have been negligible, or so badly that its effects have been positively harmful. They, too, are prospects for radical redesign, the kind of creative redesign that studies the fundamentals of a problem—markets, psychology, production, and costs—before pencil is ever set to paper.

It would be enlightening to go through an industrial register such as Thomas's, checking all of the products, consumer, commercial, and capital, which are susceptible of design for appearance. If the resulting list were marked in turn to indicate those fields which had already made a concerted attempt to increase

sales through appearance design, less than one-third of them would be found to have been so treated.

Few manufacturers expect a new design to last many years. In certain fields the factor of obsolescence has become such a matter of course that products are completely revamped every year or two. Design begets design, and, as competition grows more intense, it becomes increasingly difficult to make new designs outstanding.

NEW BLOOD

Established designers themselves should welcome new blood in the field. It sharpens competition and develops better looking merchandise, better adapted to the requirements of the market. Improvement in appearance has been gradual enough so that we forget what things looked like a generation ago. If some electric utility showroom, with its refrigerators, ranges, and lamps, could be set up exactly as it was 20 years ago alongside a modern showroom, none of us would believe that the change could have taken place in one generation.

In the future, will the majority of product designing be done in the plant or by outsiders? Again prophecy is dangerous. My own opinion is that it will not be many years before most large concerns will have design divisions of their own, headed by high-salaried designers with broad experience. In fact this has already been done in some important companies. Under them will be a staff of assistants drawn in from schools offering special training in the profession. From time to time they will call in design consultants to check the work done by their own styling division, for no matter how competent the plant's own staff may be, it can always be benefited by the criticism of an expert with a fresh eye.

Most candidates who besiege successful designers for jobs are youngsters looking for a start in life, any kind of start. They have been intrigued by the glamour that seems to have surrounded the profession. They are sometimes aware that the very designer from whom they are soliciting a job has had no formal engineering training, and they believe, with a high-school course in drafting and an ability to copy pretty girls from the covers of the movie magazines with more or less success, that they are ready to begin

work in an industrial design organization. If there is no place for them they ask, "Then how can I become an industrial designer?"

As mentioned before, many of the present successful designers never saw the inside of an engineering school. Not that the lack of special training was desirable. Many would have been saved a vast amount of trouble if at first they had not had to find out what this business of manufacturing was all about and then, through a painful process of trial and error, carve out a technique for putting their ideas into a form readily usable by industry.

Technical background is of great value, of course, but for the industrial designer it should be technical background of a special kind, particularly adapted to his needs. Merchandising, too, is quite as important as engineering, but artistic training is more important than either. It is far more necessary to have a trained eye and the instinct to judge the exact amount of a freehand curve, than to be able to compute the formula for that curve. Obviously, however, the artist with no mechanical sense should be painting pictures or making etchings or decorating lampshades rather than embarking on an industrial design career.

If you probed into the past of most of today's artist-designers you would probably find them, in youth, mending discarded alarm clocks, building boat models, and tinkering up coaster wagons to run under their own power. They had the kind of curiosity that made them want to know what makes the wheels go 'round. Along with this probably went the urge to draw. Then for a time an art education may have superseded all other interests. But finally the two streams again merged, and an industrial designer was born.

TWO KINDS OF TRAINING

In describing ways and means of preparing for the profession of industrial design we shall have to approach it from two directions: preparation with and preparation without special schooling.

At present, there are only a few courses in industrial design being offered. The best will be discussed later. But their size and geographical location is such that vast regions of the country are left without adequate special schooling in this growing profession.

If you cannot avail yourself of one of these special courses, you should first seek regular art school training. Learn to draw and

paint; study especially sculpture; take courses in design and color theory. A sound historical background in the fine arts is much to be desired. Haunt the galleries of the museums; study the history of painting and sculpture; familiarize yourself with the great basic styles in architecture, from Egypt to the present day. Industrial design is a visual art, and anything that helps to train the eye, to give it finesse and subtlety, to make it more alive to excellences of balance, rhythm, and proportion, is entirely germane to the design you may have in hand, whether it be a cigarette box or a streamlined ferryboat.

For the technical side of your training, study mechanical drawing; enroll in classes in vocational schools and learn to work on lathes, planers, and press brakes. Study the technique of die casting and foundry work. Even though you never actually touch the mass-produced articles you will eventually design, it will familiarize you with processes, and with some of the vocabulary of manufacture. Dig practical as well as theoretical information out of textbooks. Since no book of processes has been published yet for the designer, you will be forced to go through a mass of highly technical material, of value to the engineer and shopman, but somewhat detailed for you.

Trade journals are invaluable in keeping abreast of new methods, materials, and finishes. Any well-equipped library reference room will have a file of the *Industrial Arts Index*, and, by consulting the entire file, you can find certain articles of value when you wish to read up on a particular process. Only the largest libraries in metropolitan centers, however, will have complete files of the many journals listed in the index. The book-taught approach, of course, will never replace either competent instruction or practical experience.

Actual shop experience is invaluable. If you can get a job in a manufacturing plant, preferably one that makes most of its own parts, you will become familiar with the operation of various machines. Even though employed in an unskilled capacity, you can learn much by observation and by asking intelligent questions. If you are employed as a draftsman you should have an excellent opportunity to become familiar with the possibilities and limitations of many machines.

Do not neglect the problem of sales. Vocational schools and Y.M.C.A.'s often provide lecture courses in merchandising. Seize every opportunity to study methods of putting products before the public.

EXISTING EDUCATIONAL FACILITIES

Available training in industrial design, although limited in quantity, is excellent in quality. One of the best planned courses is given in an endowed technical institute* with long experience in teaching the fine and applied arts. Its department of industrial design is under the supervision of a successful industrial designer who has had several years of practical experience with big organizations.† The course of study requires three years for completion. It includes drawing and modeling, history and appreciation of art, mechanical drawing (stressing drawing for various industries), model making, market analysis and production methods, and field trips to study production processes under experts. Typical power equipment is actually installed in the school and operated by students. Engineers, merchandising men, and technical experts are brought in to give special lectures. Industrial movies are shown each week. A goodly percentage of students entering this school already have engineering degrees. The aesthetic aspects of design are emphasized, as they properly should be, but they are closely correlated with engineering and production. Particular stress is laid upon the three-dimensional approach, and "paper-designing" is reduced to a minimum.

This school conducts a placement bureau and has succeeded in locating 100 per cent of its students in industrial designing jobs. This does not mean that they are at once in a position to tackle major industrial problems, but at least they are given a chance to show their capabilities.

Another technical school, also located in the East,‡ offers industrial design courses in its college of fine arts. Classwork under various instructors includes drawing and design, anatomy, model making, casting, production methods, and lettering.

* Pratt Institute, Brooklyn, N. Y. Founded 1887.

† Donald Dohner.

‡ Carnegie Institute of Technology, Pittsburgh, Pa.

Special classes in industrial design, in which problems are studied in relation to materials, methods, and costs, are given under the guidance of a practicing designer. * This is the only course in the country in which industrial design leads to a bachelor of arts degree.

The Laboratory School of Industrial Design in New York City was originally organized as a unit of the Federal Art project under the direction of a successful American designer. † When Federal support was withdrawn in 1937, the faculty and students carried on, and it is now chartered by the Board of Regents of the State of New York.

Product design as described herein is only one part of the curriculum, which includes interior, textile, display, and advertising design.

The industrial design course, open to high-school graduates, requires four years for completion. Instruction is based on sound theoretical principles, supplemented by the case method of product development and practical shopwork. Aesthetics, art history, and field trips are also included in the curriculum. An impressive list of practicing designers forms the faculty, and the advisory council is headed by one of the pioneer industrial artists in the country. ‡

One of the best-equipped design schools in the country, again in the East, § teaches nearly every phase of the industrial crafts, from pottery and silverware to textiles and jewelry, but has not as yet placed special emphasis on industrial design as treated in this book.

There is one graduate school of industrial design. It is located on the West coast. || By graduate school is meant just that—the student must already have had advanced training both in art and science. Enrollment is small because applicants are rigorously weeded out on the basis of ability. It is the policy of the school not to duplicate the efforts of other institutions where design training is given, but to supplement and extend that training under top-notch specialists.

* Peter Müller-Munk.

† Gilbert Rohde.

‡ George Sakier.

§ Rhode Island School of Design, Providence, R. I.

|| California Graduate School of Design, Pasadena, Calif.

Instruction is given in color and form psychology, materials, manufacturing, and production methods, business administration, marketing, social and buying psychology, and comparative aesthetics. Courses are correlated with creative design and workshop practice. All school work is under the direct supervision of industrial and commercial enterprise and the second-year problems are set by industry. The supervisor of the school is an industrial designer with several years of experience, who maintains his own practice.*

There are many colleges and universities, among them Columbia, Harvard, Michigan, Ohio State, Iowa State, and New York University, where instruction in various phases of design relating to industry is given in partial form. None, however, specializes as do the others in the phases of design especially treated in this book.

Another movement, recently transplanted to this country from Germany, must be brought to the student's attention. It is an offshoot of the famous Bauhaus in Dessau, which flourished, until the political upheaval, under the guidance of the great German architect, Walter Gropius. Gropius is now at Harvard, and some of his coworkers and disciples† are trying to introduce Bauhaus methods to this country.

The Bauhaus approach is a philosophy of life as well as a method of design. It lacks, however, the realistic qualities that we Americans, rightly or wrongly, demand. Much of the writing of the group is vague to the point of complete unintelligibility, strongly reminiscent of the "manifestoes" of the modern schools of painting like the Futurists and the Synchronists. No one could be more sympathetic than I to modern movements in the fine arts, for I was one of the first to translate into English various works on modern French painters. But it will be difficult, I believe, to acclimatize the esoteric ideas of the Bauhaus in the factual atmosphere of American industry.

THE IDEAL EDUCATION

Formal school training in industrial design, available to all, is bound to come. Whether given in universities, in technical

* Walter Baermann, of Baermann and Lewis.

† L. Moholy-Nagy, The New School of Design, Chicago, Ill. Josef Albers, Black Mountain College, Black Mountain, N. C.

institutes, or in privately endowed schools is of little moment. Every technical school should eventually offer a course in aesthetic design, simply to give the engineering student a taste of the problems involved in appearance. Art studies under competent teachers should be planned, with courses in freehand drawing, modeling, painting, color theory, design (both two- and three-dimensional), and art history. Then qualified students who showed a particular aptitude for industrial design would be permitted to major in the subject.

Students enrolling for an industrial design major would be required to round out their education with elementary studies in mathematics, physics, mechanics, chemistry, and machine design, topped off with a thorough drilling in mechanical drawing and blueprint reading. Courses should be planned to treat technical subjects so that they would be especially relevant to industrial design, without burdening the student with excessive detail. In advanced classes, major industrial design projects should be worked out entirely by the student from preliminary research to finished production drawings. This would be done in collaboration with industry, bringing in sales managers, engineers, and shop superintendents for criticism of student work. The graduate would then step out of his academic circle with an adequate preparation for the years to come.

If all designers were prepared for the difficulties of production, and all engineers were in sympathy with the aesthetic aims of designers, what an industrial paradise we would have!

WOMEN IN DESIGN

Women have made names for themselves in certain semicraft fields such as textiles, ceramics, and interior decoration. But in the design of engineered products, little feminine talent has yet come to the fore. Things that women use, things that women should be designing, are being designed by men.

Product design has so far been looked upon as a hard-boiled job, filled with the thump of stamping presses, the clatter of screw machines, and long sessions in smoke-filled conference rooms. An industrial designer must be ready to set up shop in his client's plant and show how an idea can be converted into a product—at a price. Long hours over the drafting board or in the

model room, swift trips by train or motor or airplane, and endless hours of concentration, require physical effort few women are willing to expend.

Yet women are closer students of trends than men. They spend hours shopping and talking to salespeople. They make excellent style scouts and astute buyers in the housewares departments of big stores. If their ability to judge, compare, and analyze could be put to use in creating merchandise, women industrial designers would find a ready place in the sun. The profession has need of more of them.

There is no reason why the exceptionally able woman should not do just as good a job as a man. Merchandisers, advertising agents, and manufacturers have long stressed the woman's influence and the woman's point of view in retailing, and where better could that point of view be obtained than from a woman herself? Nevertheless, the type of education the American girl receives in secondary schools does not point toward a career in industrial design. The boy gets manual training, the girl domestic science. While the girl learns to compound a cake, the boy acquires a feel for metal and learns how to handle tools.

Not that the skillful operation of machines is beyond her, for woman's fingers are nimble. But her training is such that, although she takes readily to commercial art, textile design, or interior decoration, the cards are stacked against her when it comes to mechanics.

The exceptions prove the rule, of course. A woman heads the design division of one of the big mail-order houses. Another woman designed the first new method of making gloves in 300 years—a really three-dimensional job—then went into the factory and showed tradition-bound operators how to make them. Another has cut a substantial swath with designs for everything from radios to coffee mills, and knows as much about designing for plastics as anyone in the country.

WHERE CAN YOU GET A JOB?

Industrial designers have been recruited from many allied fields. Some successful ones have come from commercial art studios. There they have had some training in color, have learned to use the eye in a critical way, and have acquired facility with

drawing instruments and materials. They also know how to make effective renderings. Architectural training is helpful, too, but architects find it difficult to comprehend the exactitude of dimension required in industrial work. Furthermore, their style of drafting is so different that it has to be completely unlearned.

The beginner who can afford to study at one of the schools already mentioned is fortunate; his chances of getting a job are greatly augmented. Without school training the best introduction to the profession is to become an apprentice in a design office where a number of varied accounts are being handled, and learn by watching what others do. The free-lance design organizations in the country are not numerous, however, and the supply of applicants far exceeds the demand.

Some of the large corporations, especially in the automobile field, maintain art and color sections employing scores of artists. These departments are usually split into groups, one of which may handle the body design proper, others may do general work on accessories, packages, and displays. An apprenticeship in either atmosphere would give invaluable training to the beginner because, although he might never produce more than a radiator ornament or an ash tray for an instrument panel, he would cross swords with some of the problems industrial designers meet every day.

Another recourse is to find a job with a small manufacturer unable or unwilling to pay the price of trained professional service. Here the beginner would obtain rich practical experience; but he must be willing to start at the bottom, learning shop practice as he goes along. Unfortunately many such companies make only one type of product and the experience afforded is consequently limited.

To set up in business for yourself and begin to solicit accounts directly is still another possibility. If you have worked out problems by yourself to show as samples, you may be able to impress your prospect favorably enough to persuade him to give you an opportunity. As I have warned in a previous chapter, however, do not offer to speculate. On the other hand, be moderate in the estimate of your worth until such time as you can prove your ability to analyze the market, carry a problem logically through its many steps, and produce designs that will sell.

Do not feel that you must be connected with some huge corporation making products by the million. It is frequently better to ally yourself with small companies under progressive management and grow with them. A single outstanding product may make their reputation and yours as well.

Stop designing automobiles and airplanes; try radiator ornaments, toasters, and electric fans. Walk before you try to run. Forget publicity—too often a boomerang—and learn your trade.

HOW MUCH CAN YOU MAKE?

The young person who enters the field of design with the idea of getting rich quick will soon be disillusioned. The day of astronomical fees is past. Not that good returns are not to be had, even big returns for some. In that respect industrial design is no different from any other profession—there is always room at the top.

But how much can you expect at the beginning? That depends on how well you are prepared. Whether you go directly into industry or join the staff of some free-lance design organization, you should expect no more at the outset than a cub draftsman would be paid, unless you possess some outstanding skill such as the ability to make beautiful color renderings or first-rate presentation models. Your earnings depend on how quickly you learn and how valuable you can make yourself to your employer. Do not forget that during the first months of your employment you will probably be more of a liability than an asset. You will have to learn not only the particular ways of the studio where you are employed, but all the ins and outs of the accounts your employer serves.

One of the industrial design schools mentioned in this chapter has placed all of its students in jobs. Their total earnings for the past four years amount to about \$200,000. In 1938, 28 graduates were placed with a maximum weekly salary of \$70 and an average of \$23. The maximum is being earned by an unusual candidate, of course. \$30 to \$35 per week is usually top at the start. Your own earning capacity may be moderate at first, but with talent and hard work the possibilities for rapid advancement are good,

What the future holds for industrial design is impossible to forecast. Perhaps we are on the verge of another renaissance, when even the lowly skillet will be a work of art. And if we are, who will be its Leonardo, its Donatello, its Chippendale, its Duncan Phyfe? When we hear that one of the great mail-order houses maintains a staff of 40 men and women whose sole function it is to beautify the myriad articles scattered to every remote hamlet on the continent, we may well pause to wonder if the next 50 years will not be a more gracious era in which to live than the half century just passed.

Part II · Fundamentals

IX · Design Elements and the Third Dimension

MANY YEARS ago the great American architect Louis Sullivan, after years of search for a design principle admitting of no exceptions, felt that he had reached his goal when he declared: *Form follows function*. It became the battle cry of the new architecture, a clarion call for a return to first principles in a day when the fashion was to deck out banks to look like Greek temples and to make railroad stations resemble the baths of Diocletian.

Sullivan was right, of course, but it has taken half a century for the simple creed of making things "look like what they are" to come even to partial realization. The intelligent architect today, his client willing, tries to make office buildings look like office buildings, and homes look as if they were planned for modern living.

Of course Sullivan was too wise to insist that pure functionalism was the end of all design. ". . . Formulas are dangerous things," he once wrote. "They are apt to prove the undoing of a genuine art, however helpful they may be in the beginning to the individual. The formula of an art remains and becomes more and more rigid with time, while the spirit of that art escapes and vanishes forever. It cannot live in textbooks, in formulas, or in definitions." He believed that each building should have its own particular individuality, and he himself used much surface decoration.

Once a basic form is sound it is difficult to spoil it with decoration. The stark simplicity of much modern design, both industrial and architectural, is a violent reaction against the gingerbread of the nineteenth century, when form bore little relationship to

function, and decoration still less to form. But the soaring majesty of the best Gothic cathedrals, for all their wealth of detail, is a result of fundamentally logical engineering, which proves that a sound skeleton is not incompatible with even the most elaborate embellishment.

I have often wondered how Sullivan would have tackled some of the problems involved in modern industrial design. Aesthetically no fault can be found with the thesis that things

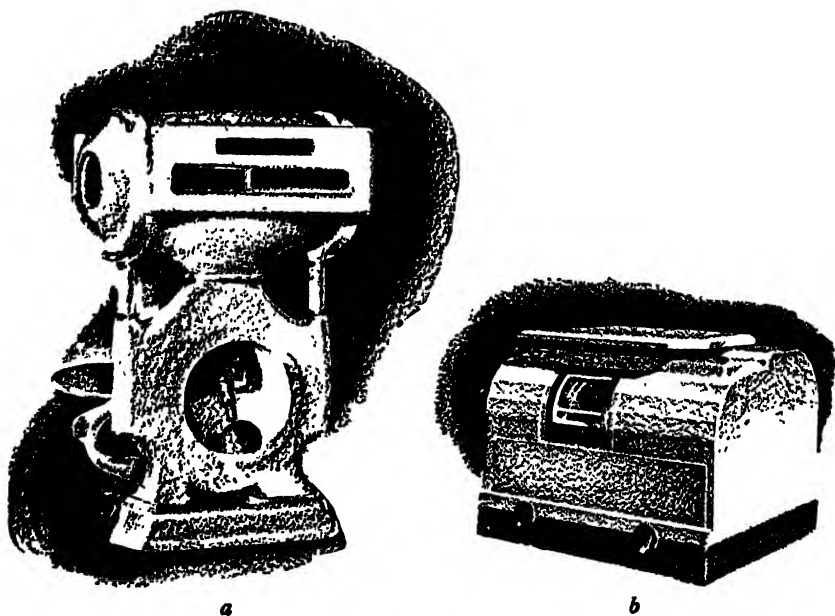


FIG. 10.

should be themselves. But with present-day engineered products we find ourselves in a dilemma, because these products are merely assemblies of dissimilar components, each of which may perform similar functions in entirely different ways.

Simple functional things retain their form identity through the centuries. A top, in order to spin, must be heavy above and taper to a point below—in other words it must be “top-heavy.” A wheel, whether rimmed with metal, rubber, or wood must be round in order to roll. A drinking cup must be bowl-shaped, at least until such time as liquids no longer seek their own level.

THE ENGINEERED PRODUCT

The more complicated a machine becomes, however, the less likelihood of its retaining any particular form identity. Modern machinery, whether used in the factory or the home, evolves with breath-taking rapidity. Because of new techniques, it may change shape completely in a decade.

Two machines performing identical functions, both in current manufacture, may not even look like distant cousins. Figure 10*a* is a weighing scale for retail markets. But so is *b*. Each contains a computing chart, levers, sectors, pivots, and counterweights.

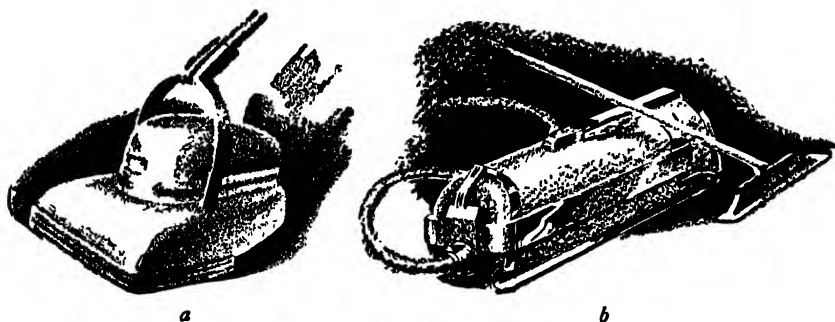


FIG. 11.

Figure 11*a* is a vacuum cleaner. But so is *b**. Each machine performs the same basic function of removing dirt from carpets by suction. The technique alone is different.

Examples could be multiplied indefinitely. Sometimes, when an industrial designer proposes a radically new form for a machine, the client will say: "But it doesn't look like a cream separator!" Very well then, just what does a cream separator look like? Is there any rule for cream separators? Careful examination of the pictorial evidence over many years may prove that cream separators can look like almost anything. Often the client's currently sold machine, in the process of evolution, has come to resemble its counterpart of years ago scarcely at all.

The average washing machine consists of a round tub, an agitator, gears, a wringer, motive power (in the form of an electric or gasoline motor), and a support or legs to bring the tub up to

* See also Plate 22.

convenient height. But because the motor is an important part of the machine, does it necessarily follow that it should be emphasized in the design? Actually, women prefer to have it concealed, because most of them are notoriously uninterested in things mechanical and because, if skirted in, the machine is easier to keep clean and easier on the eyes, and, appearing less dangerous, eliminates worry about injuries to children.

If the industrial designer took "form follows function" too literally he would strip the machine to its bare essentials, or, if he covered up the motor, drive-belt, and gear casing at all, he would carefully follow all the bumps and hollows made by these various parts with a metal stamping, which, when he was done with it, would be intricate, expensive, and difficult to clean.

Were this a book of prophecy, which it definitely is not, we might speculate endlessly about the form that modern appliances and machines—telephones, cameras, automobiles, generators—will take a century from now. If we were clairvoyant would we even recognize them? I doubt it, although their function may be precisely the same then as it is today.

How much form should follow function in today's design problems is a matter for decision in each individual case. If we were designing a drill press, our aim should certainly be to make it express its function as completely as possible, to make it the most efficient-looking drill press ever built. But it may not, it should not, look like a drill press designed in 1910. If a waffle iron were in question, we naturally would avoid making it look like a coffeepot or a wine cooler. But if someone invented a better way to make waffles, perhaps by pouring the batter into vertical slots and expanding the irons like an accordion to remove the finished delicacies, it stands to reason that the ultimate form would be different, although the function—producing waffles—remained the same.

The tendency today is definitely towards "covering things up," making them look less and less mechanical—"streamlining" them. The result is that a certain rather monotonous similarity is creeping into the products of industry, so that a refrigerator approaches a hot-water heater, and a diathermy machine cabinet may be almost indistinguishable from a radio.

The tendency toward oversimplification has perhaps been carried too far. We are wrapping everything in packages—metal packages. It is sometimes the lazy way. One day we shall swing back to expressing internal mechanisms a little more explicitly, and still retain good appearance.

A BAN ON FORMULAE

The observations set forth in this and succeeding chapters should not be thought of as a “system,” for I am not one of those who think design can be reduced to a formula. Rather they are intended to suggest things-to-look-for and ways-of-thinking; to open the eyes of the uninitiated to simple visual phenomena which may never have been called to his attention; to help him to see as an artist sees when exercising critical judgment. They are purely and simply five-finger exercises.

Most attempts to reduce design principles to rules of thumb have been concerned with two-dimensional pattern. A different tack must be taken in industrial work because it is three-dimensional. Repetition, balance, emphasis, and rhythm are all applicable to both two- and three-dimensional shapes. We shall begin with rhythm, usually left until the last. And we shall find that, in industrial design, what may be good proportion in two dimensions (elevation view), may not be good at all in relation to the three-dimensional mass.

The purpose of these chapters on design fundamentals is chiefly to train, urge, or coerce the student's mind to think automatically in terms of mass instead of lines or planes. You must acquire the sculptor's attitude rather than that of the painter or the delineator. If, in succeeding pages, we use certain two-dimensional concepts, it is merely for the purpose of developing our theme in logical fashion, or of illustrating a passing point.

Let us begin, then, with the simplest form of notation we can devise, as in Fig. 12, a single dot.



FIG. 12.

You will admit that we have chosen the most impersonal form possible. As design it means nothing; it is merely an isolated

phenomenon, made with the point of a pen or pencil and having no artistic significance. It is, so to speak, a graphic representation of the geometrician's point in space. It has location but no dimension. Before this little dot can have artistic significance, it must be placed in juxtaposition with other dots, lines, or marks. Not until then will we have the materials for design.

Very well, enlarge the dot to pictorial size, and set another of the same dimensions by its side, as in Fig. 13. Note that you are



FIG. 13.

now working in two dimensions since each dot has appreciable size.

Still pretty slim going. If you put them close enough together they have possibilities. (Set them apart and they are again two isolated points in space.) But still something is lacking. The eye



FIG. 14.

moves from one to the other, rests nowhere. Something is needed to tie them together. Why not add another dot, as in Fig. 14?

BALANCE

Now you have made progress! Believe it or not, you have the necessary tools for design. These three dots are far more fundamental than you may think. For one thing, you have acquired balance—in fact, formal or symmetrical balance. Your eye can rest more easily on three objects, even if they are all alike, than it can on two. It seeks out the dot in the center and rests gratefully there, allowing the other two to take a secondary place in your attention. The group could be given vastly increased interest by changing the position of the dots or by varying their size. But we are getting ahead of ourselves. For the time being, let us deal with dots of equal size placed in a row. We shall skip four, because we should be no better off than with two. The eye would wander aimlessly among them, never come to rest, and soon move on to more interesting visual phenomena. Let us try five as shown in Fig. 15.

Here again is an interesting arrangement. The central dot becomes the center of attention, flanked by an equal number on either side. Balance again, but danger signal! We are running full steam ahead into one of the worst of all pitfalls, monotony.



FIG. 15.

You cannot go much farther and still have good material for design. Six dots would be worse than four, seven is about the limit for sustaining interest, and even then should be attempted only by an experienced designer in conjunction with other elements which he knows to be of interest. More than seven could not possibly be recognized by the human eye as a balanced unit, for you would have to stop and count to determine whether such a large group contained an odd or an even number and you would be back where you started, with one or with two. Nothing to hold the attention. Monotony.

RAW MATERIAL

Very well, set down a monotonous number deliberately, enough so that they cannot instantly be counted by the human eye, say nine, as in Fig. 16. Now see what you can do with them.



FIG. 16.

Nine identical dots in a row. Raw material. A single drumbeat would mean nothing; it would be the audible equivalent of one dot—merely an isolated phenomenon. But an evenly spaced succession of drumbeats, the steady, monotonous throb of the tom-tom, contains the raw material of rhythm. It is unorganized, unassimilated. It needs conscious manipulation to give it interest, pattern. Fortunately, a sense of rhythm is innate in almost every human being. It is the lowest common denominator of music. Whoever responds to the simple rhythms of music can develop a feeling for the simple rhythms of design.

A series of dots prolonged beyond the capacity of the eye to count *at a glance* is obviously monotonous. It is the ticking of a

clock, the steady dripping of water from the tap into the sink. It is so monotonous that it soon fails to hold your attention and you do not even notice it, unless it happens to "get on your nerves." The mind rejects monotony, craves variety. The simplest way to obtain variety, still using the same dots for elements, would be to arrange them in groups, as in Fig. 17, with spaces between.



FIG. 17.

The spaces, or "rests" as they would be called in music, give you your first real sense of rhythmic arrangement. You have broken the monotonous spell cast by repetition and obtained the beginnings of pattern. Other groupings can be made, further increasing the interest, an example being Fig. 18.



FIG. 18.

But to return for a moment to the original nine dots. In what other ways can you vary them? By changing their size and their position. Spacing them evenly, as at first, you can enlarge every other one, as in Fig. 19.



FIG. 19.

By so doing you have given accent to the monotonous succession with which you began. It is the rhythm of a military march—ONE, two, THREE, four. A better arrangement, pictorially, would be, as in Fig. 20, the equivalent of the waltz, with an extra beat at the beginning and with part of the last bar amputated.



FIG. 20.

The waltz is far more interesting than the march, because the three large dots make for better balance than four. You can get

the feel of these rhythms by beating them out on a drum, or tapping with the knuckles on the arm of a chair, using a light tap for the small dots and a heavier one for the large dots, and prove that accent is more exciting than monotony.

ACCENT

But let us get back to dots. In accenting them with larger dots you have still preserved the even spacing of the first row. Now if you combine accents with spaces, or "rests," you can produce a whole new series of effects, much more varied than either method can separately produce. Here are a few examples in Fig. 21.

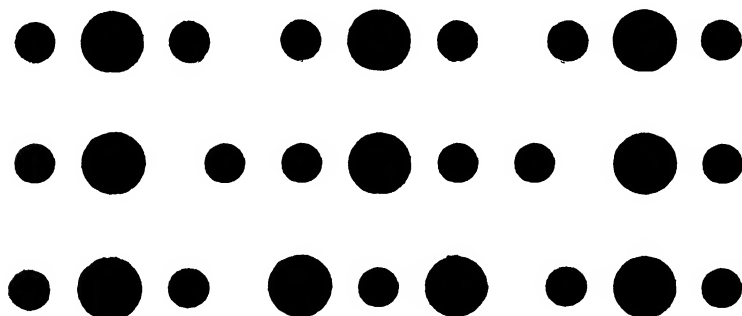


FIG. 21.

This is only the beginning of the possibilities inherent in a simple graphic form. Up to now we have confined ourselves entirely to dots arranged in a row, and have used only one weight of accent. If you were to spread out in other directions, introduce other accents, and group the spots in areas, you could soon fill many pages, for the combinations are inexhaustible. A few samples are shown in Fig. 22.

This might be instructive if you were studying pattern as applied, let us say, to textiles. But it is not often that you will have occasion, in industrial design, to apply a pattern all over a two-dimensional area.

The "saga of the dots" illustrates a number of fundamentals. We chose this simple shape because it is easily grasped and conserves illustrative space. We have let the dot stand as a symbol

for any line or shape or form with which we may be called upon to deal. It might, for instance, represent the bosses on the casting of a drill-press head, the slats on a sled, the louvers of a radio grille, the dial openings on an instrument panel—anything involving a repetition of like or similar shapes. Avoid monotonous

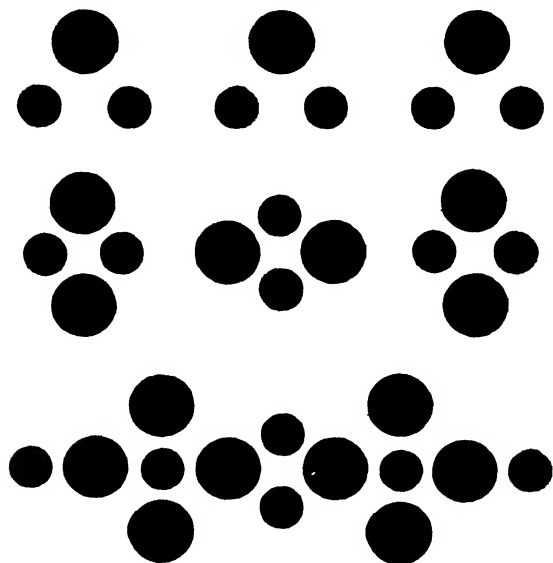


FIG. 22.

repetition. If you cannot escape using four elements, try grouping together the two in the center, thereby giving variety and accent to the design. Utilize spacing or rests to concentrate attention and create rhythm as in Fig. 23.



FIG. 23.

Perhaps a more concrete illustration is in order. Let us say we have the housing or cover of some product before us. It is a boxlike plastic molding and needs some pattern in low relief.

Ribs have been overdone in modern design, but they are simple to machine in the die, and die costs are not to be treated

lightly. They are easy to buff and polish; they are dignified and, if in a contrasting finish, may add distinction. Since you are not hampered here by necessity, choose an odd number of ribs for reasons stated above, say five. The basic form is shown in Fig. 24*a*, and an agreeable placement of five ribs shown beside it, in *b*.

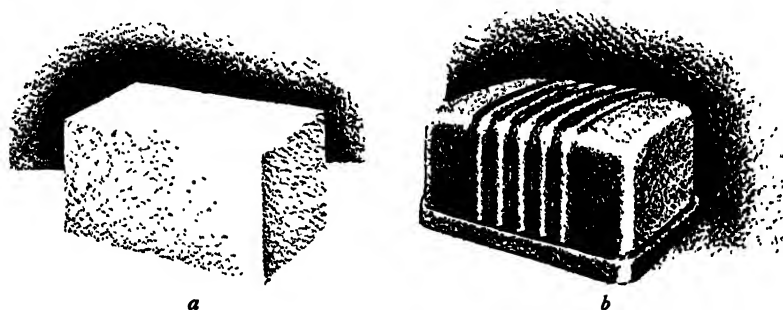


FIG. 24.

The number of rib shapes you can use is endless. They may not be ribs at all, but flutes, as in Fig. 25*a*. Or they may take the form of serrations, or flattened triangles, as in *b*. You may wish to combine different forms or accent them in different ways, or vary their width, as in *c*.

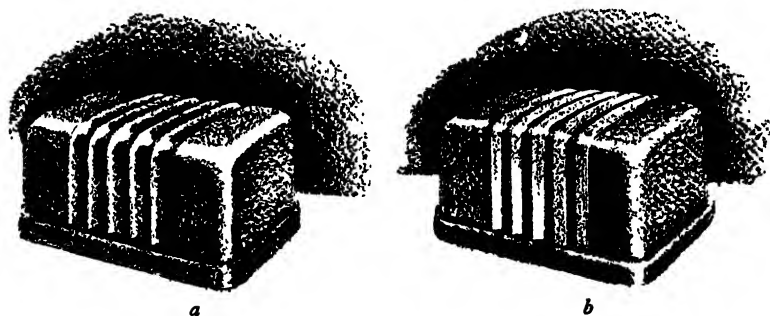


FIG. 25.

WHEN IN DOUBT

The thing you must guard against is using them at all if they are not necessary. Perhaps the cover should really be plain. If, and only if, the ribs cannot be subtracted without injury, they should remain; they have ceased to be mere embellishment and

have become a necessary element in the design. Strive always for simplicity. *When in doubt, leave it out* would be a good rule to follow.

As we have seen, the dots we began with can be manipulated endlessly. But as soon as we push them around over a flat

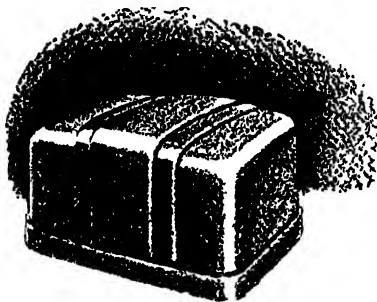


FIG. 25c.

surface, they begin to arrange themselves, almost without our help, into two-dimensional pattern, which is not in the scheme of this book. As long as they were lined up in a horizontal row we could use them as symbols, just as the rather meaningless (if you think of it) scribbles we make to represent letters of the alphabet can be arranged

into words and sentences and become symbols for ideas.

Let us, therefore, change these dots into some three-dimensional form. We have six basic shapes to choose from, the sphere, the ellipsoid, the cube, the cylinder, the pyramid, and the cone,



FIG. 26.

shown in Fig. 26. From these fundamental solids nearly all three-dimensional design may be developed.

BASIC SOLIDS

The sphere is the most fundamental solid of all. It cannot be altered without completely changing its nature, for every point on its surface is equidistant from its center. This is not true of the ellipsoid, which may have infinite variations in the relative lengths of its major and minor axes. At first glance the cube may seem to be quite as uncompromising as the sphere, for by definition its six faces are equal squares. But another cube of identical size might be placed beside it, thus altering the dimensions of four of the faces, but producing a related and homogeneous form, Fig. 27a. A sphere placed tangent to another identical

sphere would produce merely two spheres, unrelated and heterogeneous, as in *b*. Let us, therefore, consider the cube as typical of an infinitely varied group of forms having combinations of squares or rectangles for its sides, opposite sides being parallel planes.

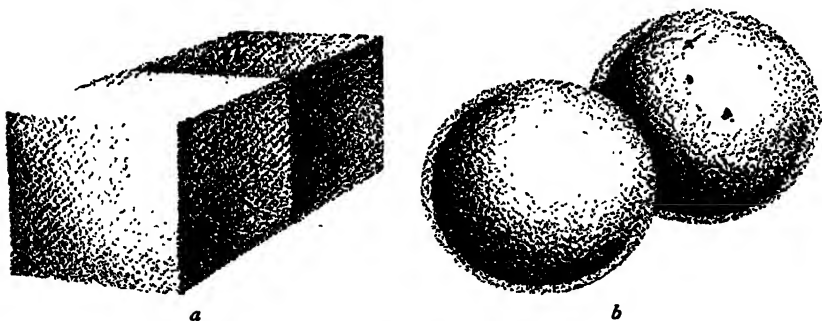


FIG. 27.

The cylinder has a fixed radius; consequently its two plane surfaces are bounded by identical circles. But its length (or height) in relation to its diameter is susceptible of infinite variation. The pyramid may have for its base a square, or a triangle, or any polygon, its distinguishing feature being triangular sides converging towards a common meeting point, or vertex.

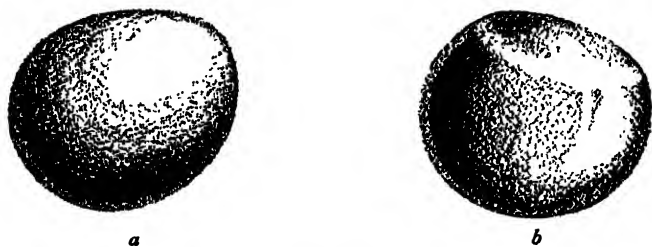


FIG. 28.

The cone differs fundamentally from the pyramid in having no plane surfaces save the circle forming its base. Both, however, may vary infinitely in the relation of height to base dimensions.

Now that we have decided to substitute a three-dimensional form for the dots, we must make a choice from among the basic shapes above. The sphere is almost too perfect for our needs;

like a woman of too classic beauty, it seems cold, unapproachable, completely self-sufficient. If you flatten a sphere slightly or push out a bump on its surface, as in Fig. 28*a* and *b*, it becomes the very negation of form—amorphous, positively absurd.

MANIPULATION OF CUBES

For purposes of illustration we need some shape more ductile, some form that can be squeezed together, pulled out like a rubber

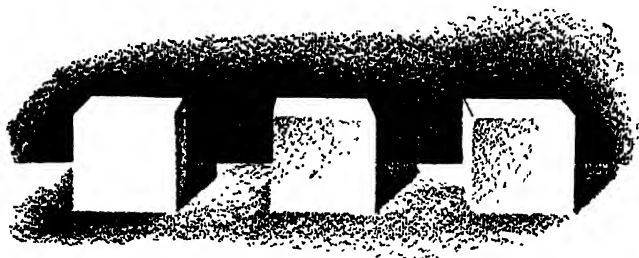


FIG. 29.

band, or otherwise worried out of shape and still look sensible. The cube will do. Very well then, we shall set up a group of three identical cubes in perspective as in Fig. 29, and see what happens.

Arrange them in a neat row so that the analogy of the three dots will be obvious. They look very prim and, like most prim

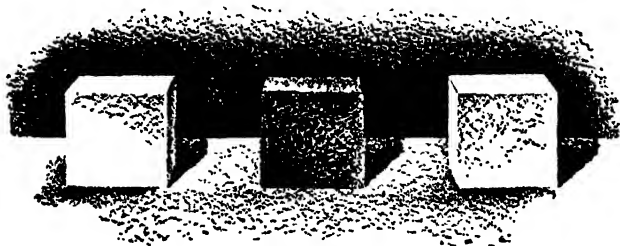


FIG. 30.

people, not exactly interesting. You will recall that the chief virtue in three dots, as opposed to two, was that there was an element of balance, the eye tending to come to rest on the center dot. The same is true of the cubes—raw material only. There-

fore, if you wish real emphasis, you must do something to accent one of them either with color, value, or size. You will have to skip color, since that is not available in a text of this nature. Value, or the use of darker or lighter shades in the scale of gray, might help, as shown in Fig. 30.

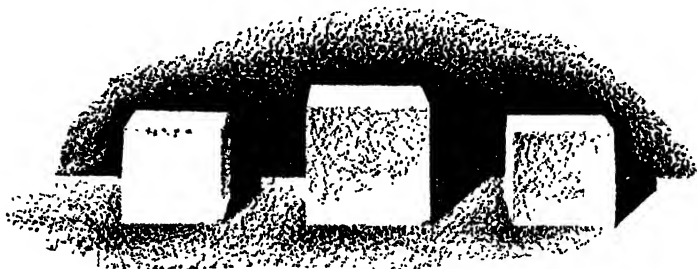


FIG. 31.

That is one way to gain emphasis if no other resources are at your command. But at the moment you are more interested in what can be done through manipulation of form in the abstract. Suppose you resort to the old trick of increasing the size of the center cube, as in Fig. 31.

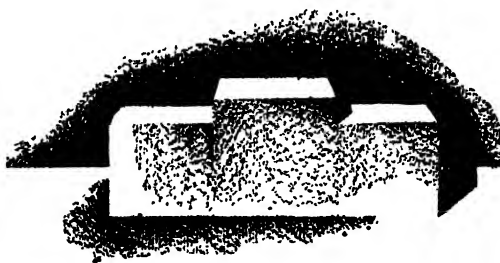


FIG. 32.

Things at once begin to look more interesting: formal balance, perfect symmetry, a dominant central motif that holds the attention, plus subordinate elements of like proportions to which the eye can wander as it lists.

Unfortunately, through preoccupation with the idea of separate dots, you now have three separate objects or forms where there should be one. The separate cubes are all very well

as symbols but you should be dealing with a single object rather than with a group of objects. Therefore eliminate the spaces between and simply push the three shapes together, as in Fig. 32.

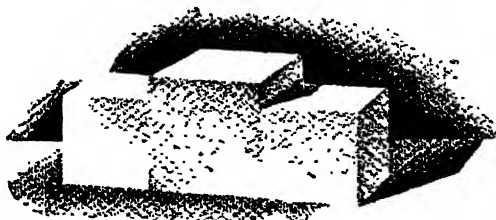


FIG. 33.

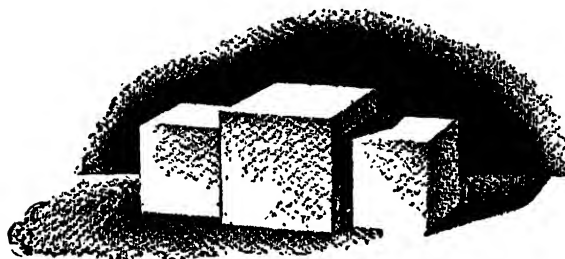


FIG. 34.

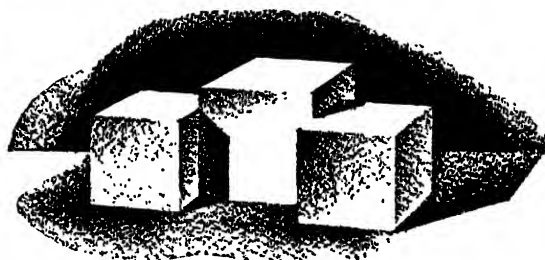


FIG. 35.

THE THIRD DIMENSION

Up to now you have had a grandstand seat directly in the center of the ball park. It might be well to wander over to the bleachers for a while and see how the game looks from there—figurative language for saying that you are dealing with three

dimensions and you should be able to walk around the design mentally and observe it from every angle, as in Fig. 33. Looking at it always from a fixed point of view, as in Fig. 32, you will never feel thoroughly at home with the forms you are supposed to manipulate.

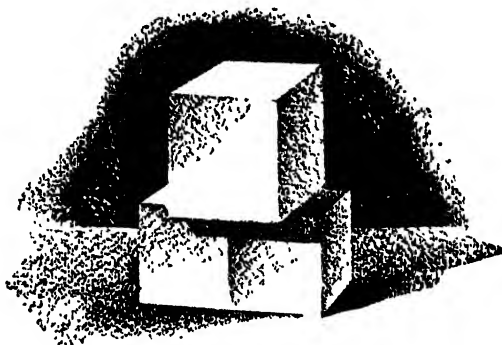


FIG. 36.

There are a number of things you might do with these simple shapes without changing their dimensions, only their position. As they stand in Fig. 33, they are rather meaningless, and perhaps you will never be able to make anything of them. They are like building blocks for children, so rigid and inflexible that, lacking the make-believe of a child who can imagine a pebble is a flower or a cube a golden coach, you may long to change their form so that they will fit more readily into the image that is taking shape in your mind. However, for better or worse, you can at least try a few experiments by altering the position of the cubes before you resort to changing their form.

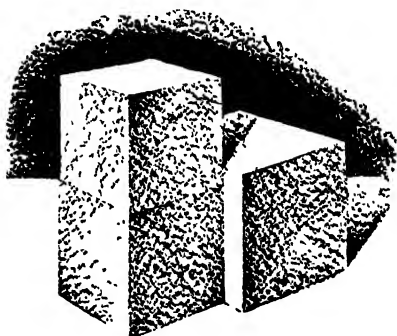


FIG. 37.

First of all, now that you have looked at them in perspective, you realize that for perfect symmetry the cubes forming the wings should be pushed back slightly so that each is centered on the sides of the center cube, as suggested in Fig. 34.

Or you could pull them forward, as in Fig. 35. In either case you have a rather more interesting arrangement than in Fig. 33.

Perhaps you might try using the two smaller cubes as a base for the large one, as in Fig. 36.

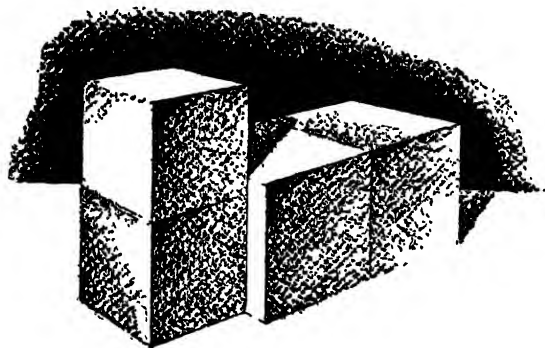


FIG. 38.

Or, for purposes of obtaining a less symmetrical design, they could be used as in Fig. 37.

To the practicing designer, most of these forms, with a little mental manipulation, can be transposed into actual products

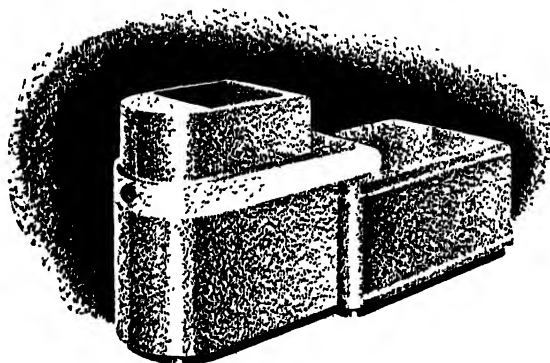
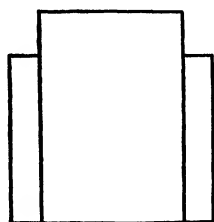


FIG. 39.

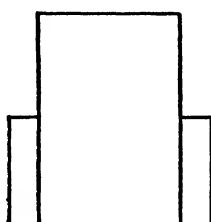
he has dealt with in his professional routine. Adding one more cube for instance, Fig. 38, recalls to my mind a vibrating conveyor which we styled. It looked approximately like Fig. 39.

The vertical form in the foreground is the dust-tight casing enclosing the hopper and the vibrating mechanism. The long

horizontal form is the enclosure around the sensitively balanced conveyor belt which receives the material (sand, chemicals, or

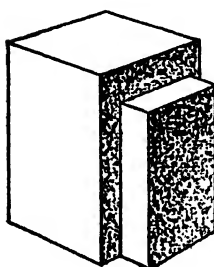


a

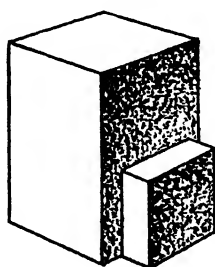


b

FIG. 40.

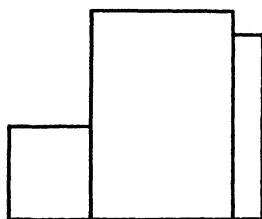


a

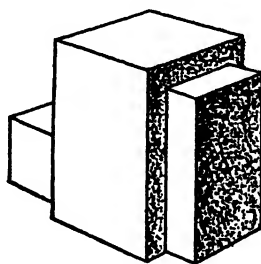


b

FIG. 41.



a



b

FIG. 42.

other dry substances) and through an ingenious series of mercury switches starts and stops the vibrator and thus measures the volume of material to exact weight.

WORKING WITH SIMPLE SOLIDS

You would do well to experiment with simple groupings of this kind, cubes, parallelepipeds, and cylinders, and to see what you can make of them. Modeling clay can easily be shaped into cubes, or you can do wonders with good white soap and a kitchen knife.

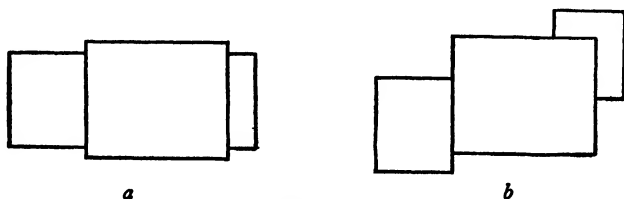


FIG. 43.

Thus far nearly all the elements we have played with, in the form of both dots and cubes, illustrate the principle of balance, even Figs. 36 and 37 if viewed from the end. In fact they illustrate a particularly rigid variety called "formal" or "symmetrical

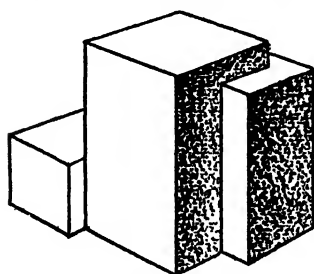


FIG. 44.

balance"; that is, right and left balance on a vertical axis. As Denman Ross says, it is a kind of balance that is "perfectly obvious and instinctively felt by everybody."

If symmetrical balance can be applied to product design, we may feel perfectly safe, providing of course that the volume relationship of the component forms is also good. For instance, in Fig. 40, both *a* and *b* illustrate symmetrical balance. (Most people however would instinctively prefer *a* because the relationship of the component areas is better than in *b*; the reasons for this will appear later.) In perspective the difference is even more apparent, as in Fig. 41*a* and *b*.

NONSYMMETRICAL BALANCE

There is a variety of balance, however, which is nonsymmetrical and which is frequently more interesting than the

symmetrical kind. Returning to the previous illustration as a point of departure, we could preserve the principal rectangle and change the shape of the wings or buttresses, as in Fig. 42a and b, producing a form that has validity and is less static than Fig. 41a. Note that the *area* of the two wings is approximately the same, but their *shape* entirely different, and that in perspective it becomes still more interesting.

We have now achieved nonsymmetrical balance on one axis. Perhaps that is sufficient. But on the other axis the balance is still symmetrical, as will be seen from the plan view in Fig. 43a.

Now push the forms about a bit as shown in Fig. 43b, bringing the left wing forward and sliding the right wing part way around to the back; you have nonsymmetrical balance on both axes still maintaining exactly the same elevation and volumes as in Fig. 42. Translate this into perspective, Fig. 44.

A rather eccentric looking mass, to be sure, but it still possesses balance, without any semblance of symmetry. Although

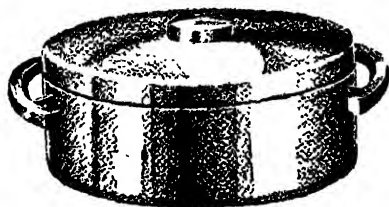


FIG. 46a.

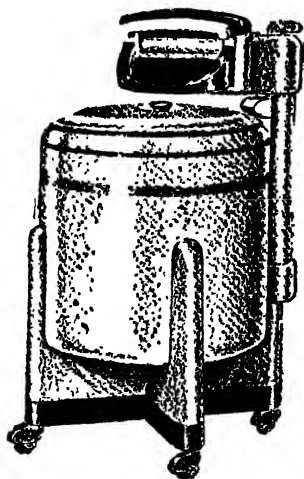


FIG. 45.

few engineered products or appliances would be likely to call for such an odd shape, it might by manipulation be made to suggest a phonograph with a cabinet for records.

To return to the blocks. You would be badly hamstrung if you were given only three to

play with and were told that all of your designs must be constructed along lines suggested by their rather limited possible combinations. With the six solids at your command, an infinite variety of shapes, all basically geometric, open up before you, without once using freehand forms and curves.

HOW SOLIDS SUGGEST MODERN PRODUCTS

The cube and its elastic variations, called in geometry by the incredibly awkward name of "rectangular parallelepipeds,"



FIG. 46.



FIG. 47a.

will probably be the most useful. Stoves, refrigerators, kitchen cabinets, even the kitchen sink, are generally variations of these forms. Down in the basement, however, the hot-water heater

and the washing machine are usually based on the cylinder, the latter with a roughly parallelepipedal form for a wringer, like Fig. 45.

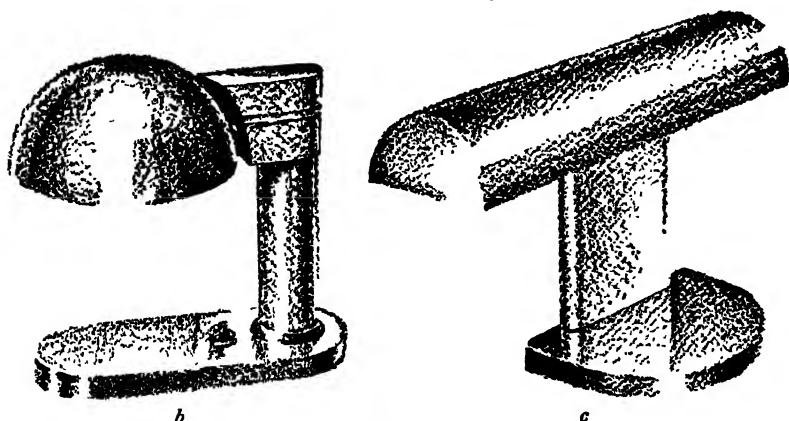


FIG. 47.

Casseroles, ice buckets, and kettles are generally cylinders, truncated cones, or hemispheres, as suggested by Fig. 46*a*, *b*, and *c*.*

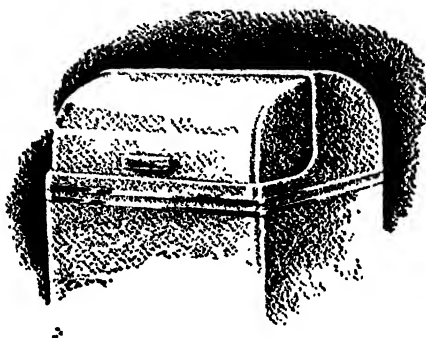


FIG. 48*a*.

A famous architectural designer created a coffee urn for a large silver company which cleverly combined a sphere with

*J. G. Rideout.

various sizes of cylinders, as shown in Fig. 47*a*,* and there are many small metal desk and table lamps on the market using simple variations of these themes, as in *b* and *c*.

Office equipment such as typewriters, adding machines, dictaphones, and duplicating devices, now on the market, frequently assume, in the hands of good designers, severely geometrical shapes combining cylindrical solids with variations of the cube, as shown in Fig. 48*a* and *b*.†

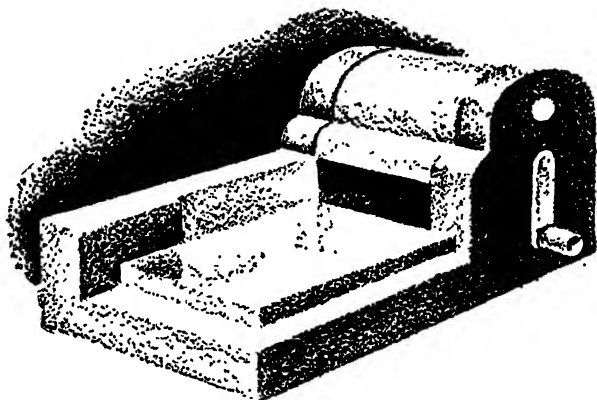


FIG. 48*b*.

Of the six basic solids, the pyramid and the cone are met with least often in industrial design, partly because they are the most difficult to fabricate by modern methods and partly because, as shapes, they are actually less useful than the others in the design of engineered products.

The student will do well to keep these basic forms always in mind, mentally stripping everyday objects of nonessentials and fitting them into combinations of these basic design shapes. It will strengthen his powers of form-analysis and help him approach design problems in terms of three-dimensional mass.

* Eliel Saarinen.

† Walter D. Teague.

X · Space Division

IT IS TIME that we went back for a moment to a neglected two-dimensional subject: space division. It would be impossible to describe or catalogue in this volume all the infinite ways in which even one space could be divided, but I may be able to offer a few suggestions which will lead the student to pursue his own inquiries into more complicated arrangements than can be shown here.

The division of any given area into several component areas may involve most of the major principles of design—repetition, balance, rhythm, proportion, and emphasis. Repetition practically defines itself as “the regular recurrence of similar elements.” Balance means an opposition of equal forces, masses, or areas, and may be either symmetrical or unsymmetrical; the difference will be demonstrated later. Rhythm has been discussed at length in a previous chapter. Proportion is the relation of one part to another, or to the whole. Emphasis is the principle by which the eye is carried first to the most important element.

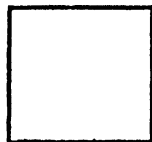


FIG. 49.

A designed mass may exhibit perfect balance, of course, and yet the proportions of its components may be quite unsatisfactory. Emphasis is a factor in obtaining rhythm; rhythm is sometimes created by sequential repetition.

Some simple exercise in space division seems to be in order. Let us choose a rectangle. You must first establish the dimensions of that rectangle in such wise that the area you begin with will be pleasing in itself. Fortunately there are certain mechanical aids to help. They are of value only in so far as they help to train the eye; you must not cling to them desperately and attempt to impose them on every problem, for in the last analysis the

eye, properly trained, is the court of last resort in all matters of design.

To produce a series of rectangles, begin with a square, as in Fig. 49. As a basis for two-dimensional design the square itself is

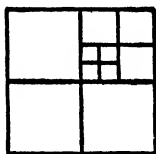


FIG. 50.

not among the most useful. To be sure, it has an air of finality, but it is static. It does not invite the eye to roam. It does not suggest

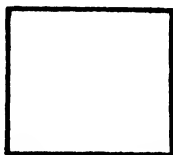


FIG. 51.

movement, which every design should possess. (I refer to the movement of interrelated form elements.) Subdividing the square symmetrically, you simply obtain other static shapes as in Fig. 50, all squares.

Now add slightly to this square, in one direction, so that its breadth is a little more than its height, as in Fig. 51.

WHAT IS A GOOD RECTANGLE?

Technically this is a rectangle, but it is not a pleasing one. Why? Because it is neither fish nor fowl—too close to a square to give the feeling of finality communicated by that shape, not enough of a rectangle to subdivide interestingly. No rectangle will be really interesting as an abstract shape until its width equals at least the diagonal of the square on which it is based, as in Fig. 52.

Another pleasing rectangular shape can be produced from this, again letting the width of the new rectangle equal the diagonal of the preceding one, as in Fig. 53.

When this procedure is carried one step further, taking the diagonal of rectangle III for width, you have a shape composed

of two contiguous squares of the size with which you started, as shown in Fig. 54. Inherently this is not so flexible as either

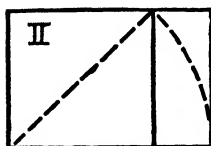


FIG. 52.

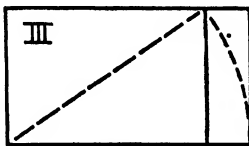


FIG. 53.

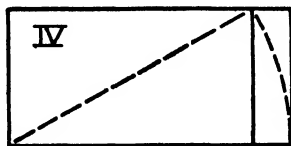


FIG. 54.

rectangle II or III and it does not subdivide so interestingly as the others.

Still another step, based as before on rectangle IV, produces a longish shape which is again replete with possibilities, as in Fig. 55.

You will notice in this series developed from a square by successive diagonals (counting the square as I) that the two shapes offering the best possibilities for interesting subdivision are III and V. (Again that rule of three and five!) Note also that IV, a rectangle composed of two identical squares, is not a particularly pleasing shape, an exact analogy to the two dots (or four) discussed in the preceding chapter.

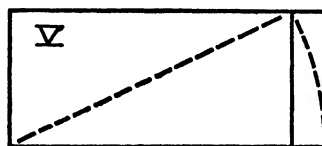


FIG. 55.

THE DIVINE SECTION

Perhaps the most completely satisfying of all rectangular shapes is based on the so-called "divine section" of Pythagoras.

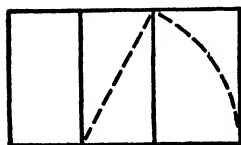


FIG. 56.

It is the ratio of extreme and mean proportion, 1 to 1.618+. Euclid showed how it could be obtained geometrically. The simplest method is to bisect the square, draw the diagonal of half the square, and produce this along the bottom line as before, as in Fig. 56.

If the main enclosing shape of an industrial product could be fitted into this shape, and the subdivisions within the shape agreeably made, your problem, at least in its two-dimensional aspect, would be quickly solved. This remarkable shape is susceptible of artistic subdivision in almost unlimited ways. If

you care to explore its possibilities, you would do well to secure Jay Hambidge's *Elements of Dynamic Symmetry*, where you will find the vast ramifications of this and other simple geometric forms thoroughly analyzed and developed. But we must forego such advanced speculations and confine ourselves to simple diagrams. Now take one of the shapes you have developed, the Euclidean rectangle. You would not divide it (*a* in Fig. 57) into two parts. (Remember the dots.) Three equal parts would be

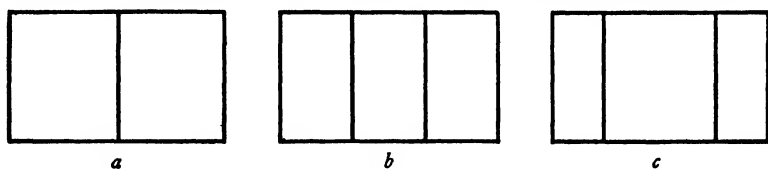


FIG. 57.

more effective, *b*, but, as with the three equally spaced dots, this leaves much to be desired. It is better, of course, to make shapes alike than almost alike. But it is still better to make them distinctly unlike, for the sake of emphasis and variety. Therefore, widen the central portion considerably so that the two resulting end areas are quite different from the center area, *c*.

THE EYE AS GUIDE

The exact location of the lines necessary to divide the rectangle so that the resulting areas bear the most agreeable com-

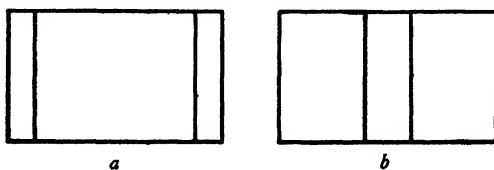


FIG. 58.

parative relationship to each other could be demonstrated with instruments; but it is time to cultivate the habit of letting the eye dictate the best balance of the elements. You would not, for instance, divide it in either way shown in Fig. 58, that is, if the entire rectangle were of the same color and value (for example, all gray or all tan).

Fig. 57*c* is surely superior to any of the others if you are seeking formal balance and an agreeable proportion, or com-

parative relationship, between component elements. You have also attained unity by means of a predominant area—"a weapon of defense," as W. A. Dwiggins says, "against surrounding competitive matter."* But, although Fig. 57c might be perfect if you were dealing only with areas of the same tone value, you might want the central portion darker. In this case the central area might overbalance the lighter flanking wings, as shown in

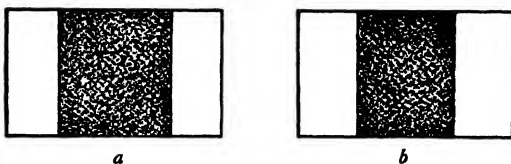


FIG. 59.

Fig. 59a, and you would have to make an adjustment, by narrowing it, to secure the correct visual balance, as in b.

The same would be true if you modified the whole shape by adding more area to the central portion, as in Fig. 60a. This would demand a slight enlargement of the wings to compensate, as in b.

The texture of the finish would also have a bearing on your decision. If the wings were bright chrome and the center satin finish, the polished metal would be overpowering, and more

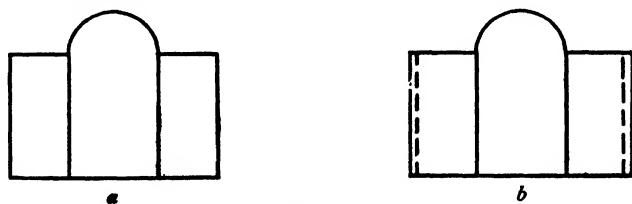


FIG. 60.

space should be given to the satin finish. Such refinements take judgment and experience, but as the eye gradually becomes trained, they seem to follow a certain inexorable visual logic.

As an example of balanced design in two dimensions, Fig. 60 is unimpeachable. You will find it in one modification or another throughout the history of architecture: in triumphal arches

* *Layout in Advertising*. By W. A. Dwiggins. Page 56. Harper & Brothers, New York, 1928.

from Roman times, in window groups from the Renaissance, in formal interiors. Paintings, usually altar pieces, executed in this general shape are known as "triptychs" and may be found repeated over and over again in the religious art of Italy, France, Germany, and Flanders. The central area makes an ideal frame for figures of the Virgin and Child, the customary groups of saints being depicted in the wings.

This arrangement derives its dignity and impressiveness from the fact that it has "formal balance"—a central dominating or accented shape, flanked by minor shapes of equal size. No one of these shapes alone would be of particular interest, but together they display some of the major principles of good design—rhythm, balance, emphasis, and unity.

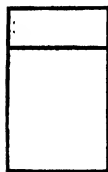


FIG. 61.

Now turn this at right angles and draw a side view, letting the total area of the side make another good rectangle, as shown in Fig. 61.

Let us now swing the flat shape shown in Fig. 62 into perspective, as if it still had but two dimensions, its thickness still being theoretical, or, if you will, the thickness of a sheet of paper.

Now push the entire shape back into space at 90° until its side has assumed the shape called for by the side view, as in Fig. 63; then shade it.

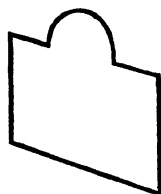


FIG. 62.

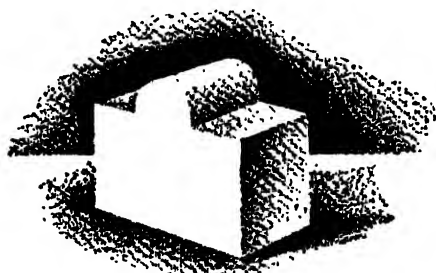


FIG. 63.

The result is disappointing. For one thing it is pretty bare, proving that a shape which may be interesting in the flat may not be particularly effective when projected into deep space. Now that the design is shown as a solid, the problem has assumed a different aspect.

Another reason why it is disappointing is that the vertical lines, which satisfactorily divided the flat shape (Fig. 60) into three varied areas, are no longer of any use when you throw it into mass seen in perspective. You have eliminated them purposely, because, now that you are dealing with three-dimensional form, you must throw overboard all purely two-dimensional aspects and think in terms of solids. At best, these lines could only be included in the design as ribs or beads or painted stripes, and they would count for very little as you can see for yourself in Fig. 64.

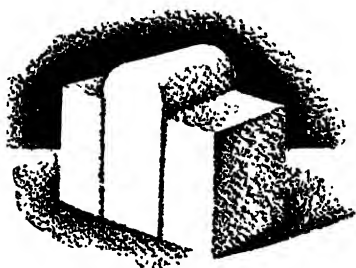


FIG. 64.

Further, you discover that your Euclidean rectangle, which you know to be a beautifully proportioned area, has completely disappeared in the perspective view, and at the end of the wing you now have an area which is almost a square, but not quite; and, if you have learned your lesson from the preceding chapter, an "almost" square shape is to be as shunned as the plague. (If it is unavoidable, however, due to the nature of the product, much

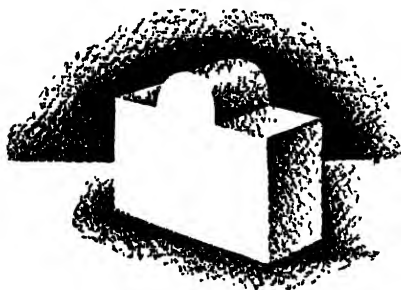


FIG. 65.

can be done to improve it, as shown in Chap. XI.) In fact, it was quite useless to attempt to make the side view (Fig. 61) another Euclidean rectangle because the draftsman's "side view" of any design is a purely arbitrary conception. Visually it is nonexistent, although it is a convenient way of working on the drawing board.

Very few have sufficient powers of visualization to "see" even a fairly simple design in their mind's eye when confronted with the usual elevation, plan, and side view. That is why the architect shows the home builder a perspective sketch, and why the industrial designer shows his client a perspective rendering or a model. Of course if the only function of the designer were to make perspectives of already existing designs, it would be folly

to engage him, for anybody can “bone up” on perspective from a book. The designer must be able also to manipulate shapes, to think in terms of forms seen in mass rather than in line.

To return to our design. You have been worried about its bareness as it appears in Fig. 63, and about that almost square shape at the end of the wing. You might resort to the device of changing the square to a more agreeable rectangle. Try the Euclidean once more, as in Fig. 65.

Perhaps you have improved matters somewhat. You have been forced to narrow the whole mass, but there is nothing actually wrong with the result. It is narrower, that's all. The real trouble is, you are still thinking in the wrong way. You are modifying small parts of the design, a side at a time, without regard for the whole. Take the bit in your teeth and let that dominant central motive really dominate the whole design, but do so in three dimensions as well as in the flat. You can do this by returning to Fig. 63 and pinching in the flanking wings, as shown in Fig. 66.

THREE-DIMENSIONAL THINKING

Now for the first time you have begun to visualize in three dimensions! Hitherto you have taken only hesitant steps, but

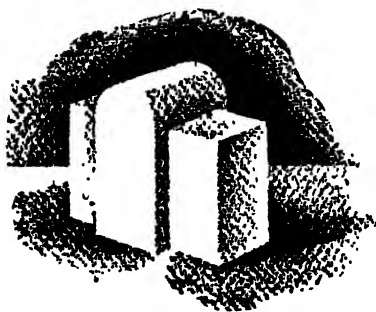


FIG. 66.

now you are manipulating masses rather than lines—the all-important thing. By this change you have accomplished several objectives. You have broken up the flat mass of the front so that it ceases to look quite so bare. You have increased the dominance of the central mass, thus giving it three-dimensional emphasis and

rhythm. Automatically, you have forced that squarish shape on the end to become a more positive rectangle, without changing the depth of the central mass originally established in Fig. 63. You have broken the straight base line and produced a varied line possessing far more interest, one that changes constantly as the position of the spectator changes.

In fact, if you now draw a plan view of the object, you will find that by manipulating the mass you have also unwittingly

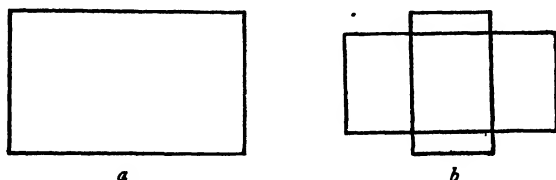


FIG. 67.

given point and style to the plan. That is, in place of a single rectangle (Fig. 67*a*) you now have two intersecting rectangles, as in *b*.

You will note also that the masses have been manipulated so that, in effect, you have a central vertical mass of distinctive shape actually penetrated by another mass utterly different in shape, consisting of a rectangular parallelepiped, the end of which you can convert into any of the rectangles in your series. Figure 68 shows the masses skeletonized.

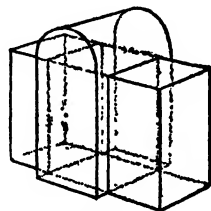


FIG. 68.

At the risk of seeming repetitious, let me again point out that you are now thinking in three dimensions, an absolute requisite for industrial design. The simple step of pinching in the wings has liberated your imagination and opened up unexpected vistas. Now you can let yourself go and play with dozens of ideas that occur to you.

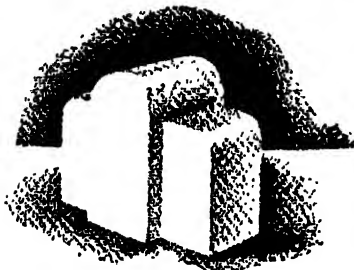


FIG. 69.

VARIATIONS ON A THEME

For one thing, you notice that the horizontal mass is rather harsh and uncompromising compared with the gentler vertical mass which it penetrates to form the wings. You might round it off in the vertical plane, as in Fig. 69.

This is not entirely satisfactory, however, for it succeeds only in giving the same vertical feel to the wings and repeating the curves of the central mass. It is monotonous. There may be

some other and better way of accomplishing the result. How about rounding the mass off in the horizontal plane instead, as in Fig. 70?

Much better. For one thing, there is better contrast, more variety. You are now treating the two masses as they should be treated, namely, as well-differentiated but entirely harmonious forms. You may wish to emphasize the horizontality of one plane movement by further embellishment, as in Fig. 71.

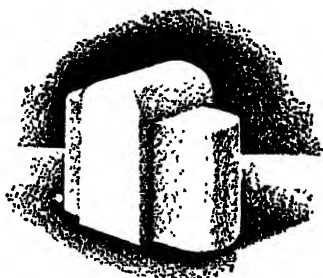


FIG. 70.

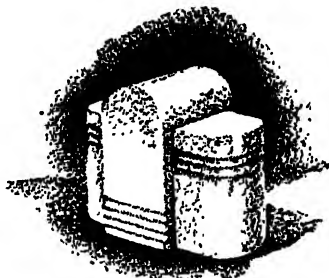


FIG. 71.

We could go on indefinitely altering and refining these forms, but this brief demonstration should be sufficient to point the way. Intentionally I have chosen an abstract shape, without reference to what sort of product it might be. In actual practice we should probably have much less freedom than this, due to the many limiting factors in industrial problems.

At that, if we use a little imagination it would not be hard to supply in the mind's eye a dial and hands, and think of our design as a mantel clock; or it might be the housing for a conversion burner for furnaces, or a molded plastic box containing a manicure set for the dressing table.

XI · Subtleties

DESIGN IS fundamentally the art of using lines, forms, tones, colors, and textures to arouse an emotional reaction in the beholder. Whether the emotion evoked is the genuine thrill communicated by an object of great intrinsic beauty, or merely the desire of possession, is beside the point. The designer fails only when the beholder remains completely indifferent.

Effective design cannot be created without emotion, and it will not be communicated to others unless it is present in the designer during the act of creation. No amount of theory, used cold-bloodedly without accompanying creative enthusiasm, will produce successful design, because it is a matter of feeling far more than reasoning.

Every art, however, has its technique. There are certain effects developed over the centuries which, because they are derived from universally apprehended phenomena, have become the stock in trade of all subsequent designers. They are analogous to the follow-through of a tennis stroke or to relaxed arm weight in playing the piano. If one knows them, they become almost subconscious and produce a certain premeditated result.

Once these effects are understood, they may be used quite independently of the emotional phase of the creative process. And they will often add subtlety and refinement—the finishing touch that may save a design from mediocrity.

The principles referred to stem mostly from certain optical phenomena experienced by people with normal vision. If the designer is aware of them and knows when to use them, he will be able better to make the beholder's eye do his bidding. In the industrial design field, the raw material is more often than not awkward and difficult. A given rectangle may be too long to be a

pleasing or easily divided shape, and yet not long enough to become a mere band. On the other hand, it may approach too closely to a square to be agreeable (see Chap. X). Limitations of space and mechanical considerations may make this particular rectangle impossible to change.

OPTICAL ILLUSIONS

If such is the case, the designer has at his command certain resources to trick the eye into seeing the shape as a form which it is not. One of these resources may be demonstrated, in the manner of the familiar optical illusions, by dividing two identical rectangles with lines in opposite directions, thus making them appear quite different shapes, as in Fig. 72.

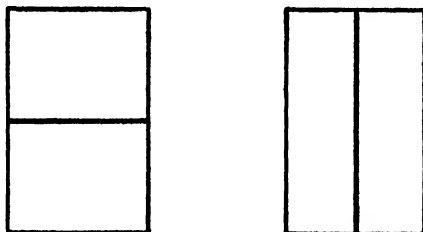


FIG. 72.

It is the same trick used by skyscraper architects, who emphasize the verticality of their tall spires by using reveals continued vertically between bands of windows. Recent architectural thinking considers it dishonest, because a skyscraper is merely a succession of horizontal floor arches, one piled on top of another. The tendency today is to emphasize the horizontal window bands at each floor, or at least to let them be what they are—just windows. Regardless of which is architecturally more sound, the latter treatment makes a building look shorter, as in Fig. 73*a* and *b*. Dress designers use the same principle in making dumpy figures seem slimmer, or the reverse.

A domestic furnace stoker will demonstrate this simple principle. The manufacturer presents us with mechanical drawings of the device with its hopper, motor, reducing gears, and feed worm. Our job is to enclose it in a simple and inexpensive sheet-metal housing with hinged cover. We find that the dimensions of the hopper and other parts to be enclosed are such that

the rectangle formed by the side elevation of the housing is not quite a square. We try various ways to elongate this undistinguished form, but we cannot decrease the length without reduc-

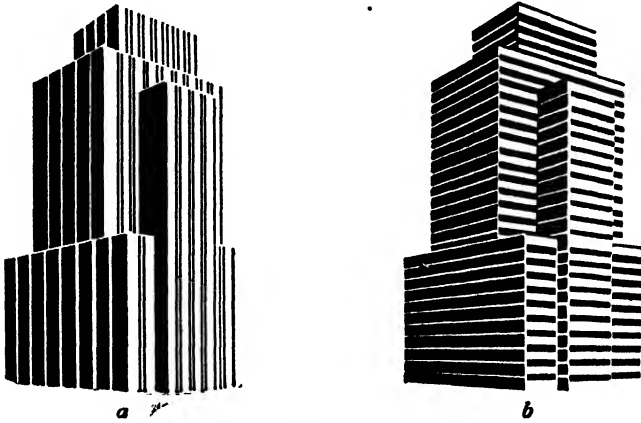


FIG. 73.

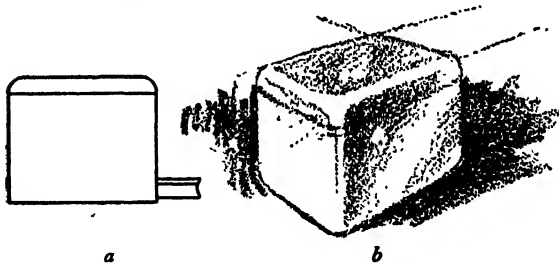


FIG. 74.

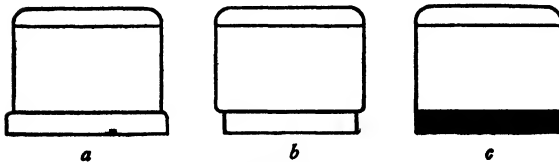


FIG. 75.

ing hopper capacity, or increase it without housing too much "air." The side elevation and a first rough perspective layout will be seen in Fig. 74*a* and *b*.

Due to the comparatively small sales volume in this particular item, the client will invest in dies only for forming the cover; the rest of the housing must be fabricated on power brakes. Various possible methods of making this awkward rectangle more pleasing are shown in Fig. 75*a*, which introduces horizontal

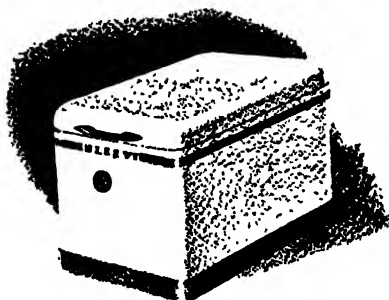


FIG. 76.

lines by "revealing" a band around the bottom; *b* accomplishes the same result somewhat better by recessing the base; *c* does the same by the simpler means of a change of color—merely applying a painted black band. Both *a* and *b* increase the cost; *c* is therefore adopted, although it is not quite so effective a solution as *b*. When the design is

nearing completion, it is decided to embellish it further by the addition of another horizontal stripe above, in a deeper value of the body color, and make this stripe continuous across the front with the company name. A lid handle is added, and the company trade-mark spotted agreeably in relation to the stripe, not too close to interfere with reading, not too far away to appear isolated. Figure 76 shows the result.

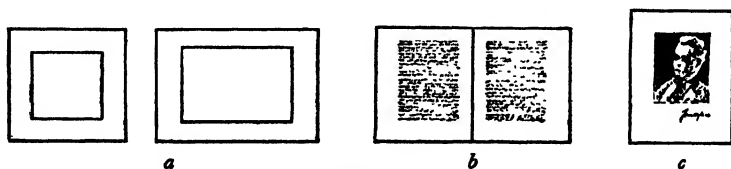


FIG. 77.

DIMINISHING RECTILINEAR SHAPES

Another simple optical fact is that a square within a square or a rectangle within a similar rectangle, if placed geometrically in the center, will appear to be below center, as in Fig. 77*a*. Therefore we should always place the inner panel somewhat above center—how much above is a matter for experiment in each individual case. Book designers always allow more margin

below the type block than above, and a little off center towards the middle of the book, *b*. Photographers in mounting portraits frequently exaggerate this "above center" rule to allow for a signature or label, *c*.

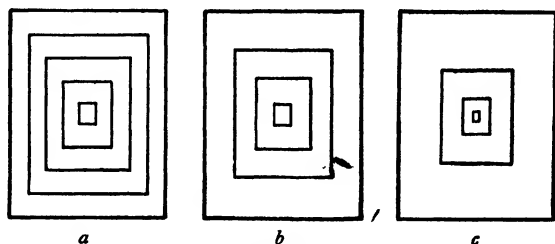


FIG. 78.

The reason for this is not so easy to discover. Perhaps it is because the eye, as Denman Ross says, has a tendency to "read upwards" in looking at any object; but unless the inner panel is above center, it will *appear* to be below. At all events, it is a simple rule to remember, and one of the ABC's of design.

If we are dealing with a series of diminishing squares or rectangles one within the other such as the lid of a molded cigarette box, or the base of a desk lamp, we shall find that even spacing of the elements (Fig. 78*a*) is less interesting than progressive spacing. Progressive spacing seems to give the feeling of growth; even spacing remains static. Drop a stone into a quiet pool—the ripples obey some occult law of progressive spacing.

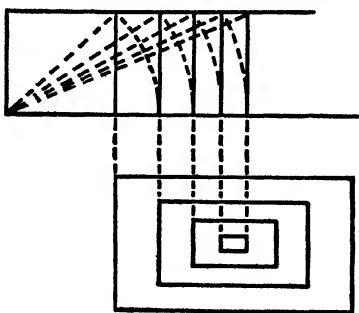


FIG. 79.

But what rule will give us the amount of progression? If the eye is trained, one can experiment until spacing looks right, but the novice may feel the need for some mechanical aid. Geometrical progression (each increment the square of the preceding) moves too fast (Fig. 78*c*). Even arithmetical progression (each increment double the preceding) may increase too rapidly (Fig. 78*b*).

There is, however, another kind of dynamic progression which always gives a sense of satisfaction to the eye. It is based on our rectangle series. Beginning with a square, lay out a series of rectangles each of which is based on the diagonal of the preceding one. Go as far as you care to, then start at any point, working backward, to obtain the increments from the center of the square or rectangle, as in Fig. 79.

THE ARTFUL GREEKS

The Greeks were masters of subtlety. Greek architecture, which to the casual eye may seem quite formal and regular, is

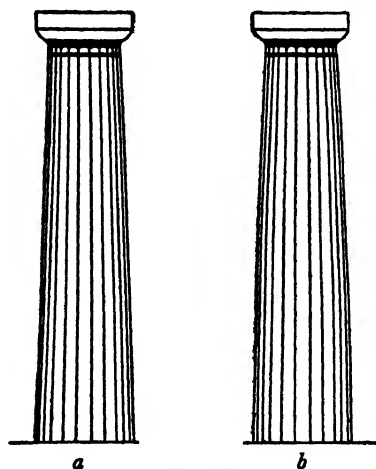


FIG. 80.

full of delicately refined irregularities. There are few straight lines in Greek temples, rather a series of curvatures, so subtle that for centuries most of them went unobserved. Then, in 1810, an English architect named Pennethorne began studying them, and, together with later students, proved that they were not accidental, but artfully contrived to avoid the cold monotony of geometrically regular lines.

One of the most obvious of these devices, known and copied long before Pennethorne's time, is the swelling of a column to avoid the "knock-kneed" effect produced by the two almost parallel lines of its sides as they taper upwards. It is known as "entasis," the Greek word for "a stretching." The entasis on a column of the Parthenon, for instance, reaches its maximum at about two-fifths of its height, and amounts to only $\frac{2}{3}$ inch on the radius. Yet it is sufficient to overcome the concave effect that would have been produced by straight lines. Figure 80*a* is a Doric column with straight sides to show the effect of concavity; *b* illustrates the classical entasis (although it has been exaggerated several times in the small illustration because the actual columns are 80 feet high).

The actual application of entasis to products would be difficult, for few products or even machines are tall enough to make the device of any particular value. We should be checkmated, too, by the materials used in industrial design or the particular process of manufacture employed: entasis would be impossible, for instance, in working with sheet metal fabricated on brakes; it would be difficult and costly in stampings. It might be a possibility in casting or plastic molding processes, but would be of little value unless the item were of considerable size.

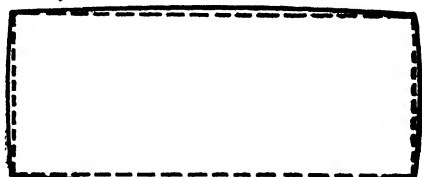


FIG. 81.

Analogous curvatures, however, were used by classical architects in other ways that will be useful to the industrial designer. Discussion still rages in archaeological circles over

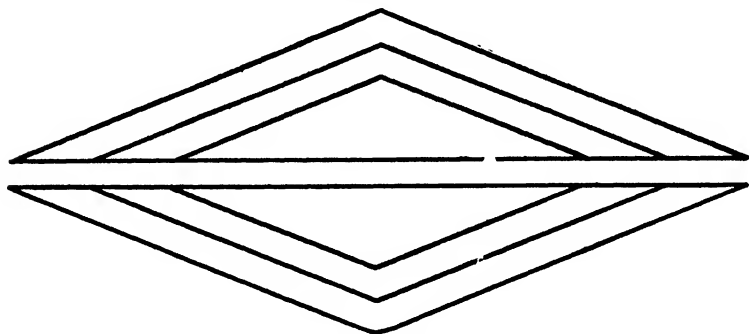


FIG. 82.

their actual purpose, some contending that they were employed to overcome optical illusions and make lines *look* straight, others that they were intended simply to give life and vigor to the buildings. It is generally conceded, however, that the upward swelling of the platform, or main slab of the Parthenon floor, was intended to prevent an otherwise horizontal surface from looking "dished." Since that famous temple measures 228 feet by 100 feet, and the maximum curvature reaches only 4 inches in the center of the long sides and $2\frac{3}{4}$ inches in the center of the short

sides, it will readily be understood why it went unnoticed for so long.

Furthermore, the plan of some Greek temples is not rectangular at all, but slightly bowed outward (Fig. 81). The lines of the Parthenon entablature are also cambered slightly to match the upward swelling of the platform. In the latter case it is clear that this is necessary to overcome the appearance of "sag" due to the optical illusion created by the flat triangular lines of the gable or pediment. Figure 82 illustrates the illusion by analogy.

APPLICATION OF SWELLED LINES

Let us seek a problem that might be encountered in industrial design to see if we may find some use for these subtleties invented

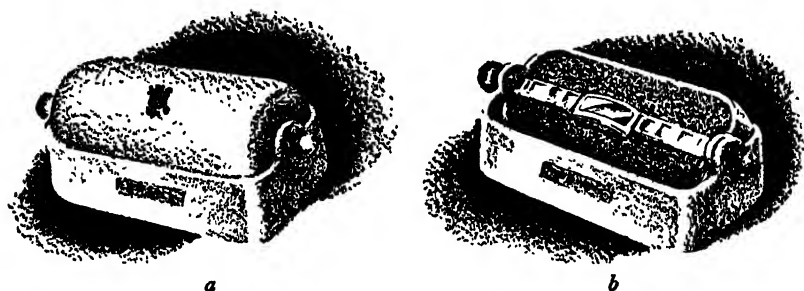


FIG. 83.

by the crafty Greek. Suppose we were designing a display box for wrist watches. It will be molded of a urea plastic, ornamented with gold-plated trim. From dozens of idea sketches we have chosen the design shown in Fig. 83 (*a*, closed; *b*, open for display).

The surfaces are severely simple, with large, soft radii, to bring out the maximum richness of the plastic material. We lay it out in plan, elevation, and side view and dimension it, turning it over to the model maker to be translated into plaster. When the smooth white plaster box comes from the model shop, we find it somehow disappointing. After some study we realize what is wrong with it (Fig. 84*a*). The bottom only, or tray part, is shown. The large radii at the four corners, plan view *b*, seem to have a tendency to make the box look concave on the two long sides. The reason for this, we now realize, is that the eye has a tendency to follow the radii around in order to attempt to com-

plete the circle, *c*. Once the difficulty is recognized, the obvious cure is to give a slight convex curvature to the long sides, so very slight that the resulting form cannot appear concave, as in *d*.

Due to the popular trend away from sharp and edgy metal forms, and the substitution of large soft radii at corners and edges, the curvature device has become more and more important. Every designer now knows that, unless he employs it, or some similar trick, plain sheet-metal surfaces will be likely to

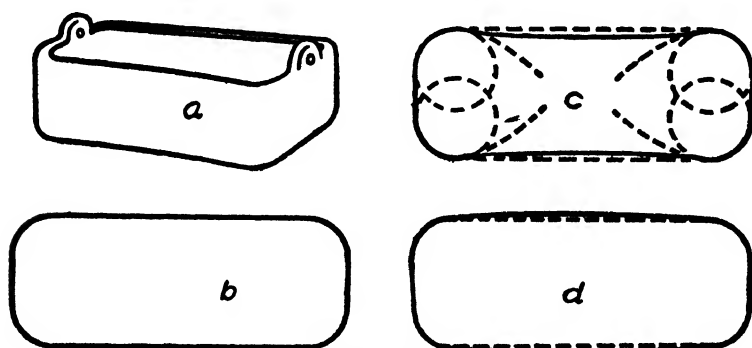


FIG. 84.

have the “dished” appearance that the Greeks cleverly avoided. It is useful in the design of refrigerators, stoves, cabinets, water-heater housings, ironing machines, and a host of other appliances where stampings are employed. It has a practical value too, for it tends to stiffen the stamping, preventing the flat area of metal from snapping in and out when touched, commonly dubbed the “oil-can” effect. The designer will often increase the swelling, of course, to the point where it becomes noticeably bulged; witness most refrigerator doors. This is entirely legitimate if it is the effect desired, but it ceases to be analogous to Greek entasis, or camber.

SUBSTITUTE DEVICES

When curvatures are not practical because of die cost, there are substitute devices that may sometimes be employed. If used with discrimination, a flat surface may be peaked in the center between corner radii. Some designers in fact use this effect so frequently that it has become almost a trade-mark of

their work. Let us take a service-station lubricating cabinet to illustrate. The unit consists of a square dolly with four casters on which a 100-pound drum of grease is placed. Over this, concealing both drum and dolly and supported by the latter, is placed a sheet-metal cabinet, consisting of an offset base enameled black, two bent sheets lock-seamed to form the body,

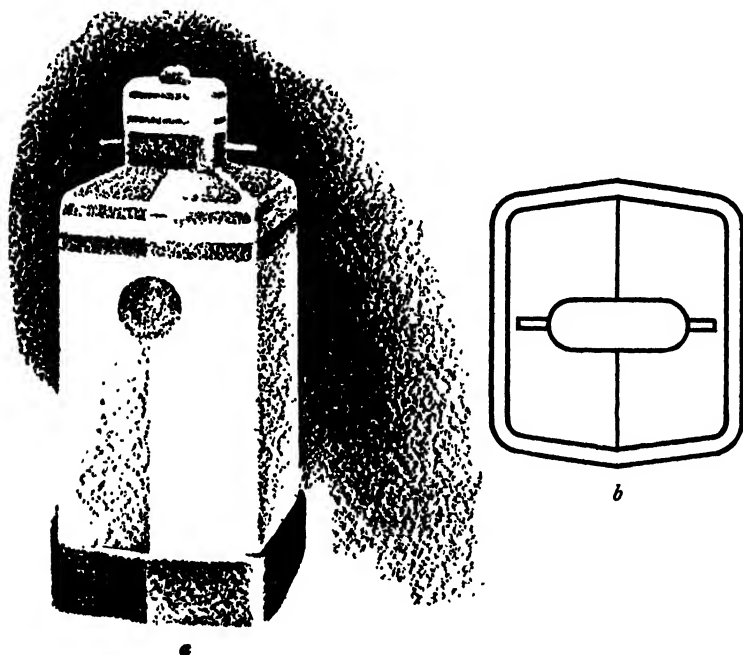


FIG. 85.

and a cover stamping on which is mounted the pump mechanism and to which are attached air and grease hoses. A long tube attached to the pump extends downward almost to the bottom of the drum and compressed air forces the grease through the hose and out through the gun. Figure 85 shows the finished cabinet, *a*, and a plan view, *b*.

For economy's sake the cabinet must be made, if possible, with few dies. The cover only will be a stamping; the base will be formed on simple bending dies and a small radius put in the upper edge with rolls; the body of the cabinet will be fabricated on brakes; the pump housing will be die castings. The cover

being stamped out on a die, it will be a simple matter to form it with a slight peak front and back, which blends out a few inches back from the edge. To make the body of the cabinet conform to this shape, the cabinet is fabricated in two halves. After the vertical corner radii are formed on brakes, each half is placed in a simple die and a peak formed down the center. Without this device, the cabinet, which is practically square in plan view, would lack character. The division of planes created by the peak subtly varies the half-lights and high lights and gives variety to an otherwise monotonous plane. Figure 86 shows the separate parts involved in the design.

Concentric circles are subject to the same manipulation as the square within a square mentioned above. The same method of obtaining a dynamic versus a static effect may be applied to them (Fig. 87*a* and *b*).

CYLINDRICAL SUBTLETIES

Cylindrical forms are difficult to manipulate successfully unless you are aware of some of the strange distortions that may occur if you stick too closely to pure geometry. As illustration, we shall use another lubricating cabinet, of more modern design.

The trade clamors for a streamlined unit in which the pumping mechanism is completely concealed. This time we have chosen a cylindrical theme, and the finished device will be seen in Fig. 88. In order to conceal the pump and not make the cylinder too high, a hemispherical dome is placed atop the cylinder and a revealed band, crested on top to clear the pumping mechanism inside, is wrapped over the entire cabinet body.

From the sketch it would seem to be plain sailing: nearly all perfect geometrical forms, except for the crest which is elliptical in side view; but such is not the case. As we proceed with scale

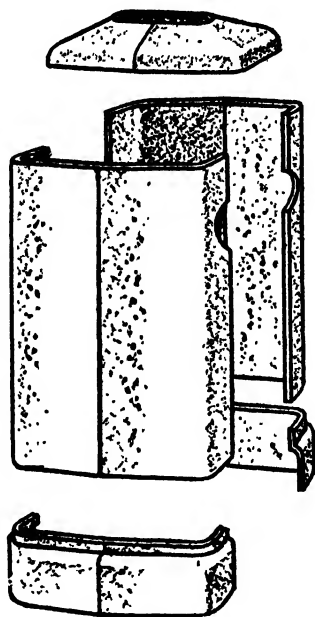


FIG. 86.

models in clay we find that all is not well in the state of Denmark. Figure 89a shows a plan view treated geometrically, a perfect circle, intersected by a band whose two ends are concentric

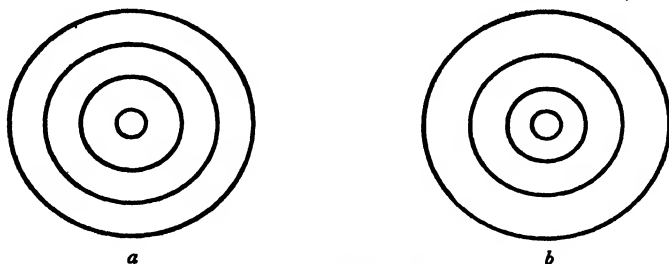


FIG. 87.

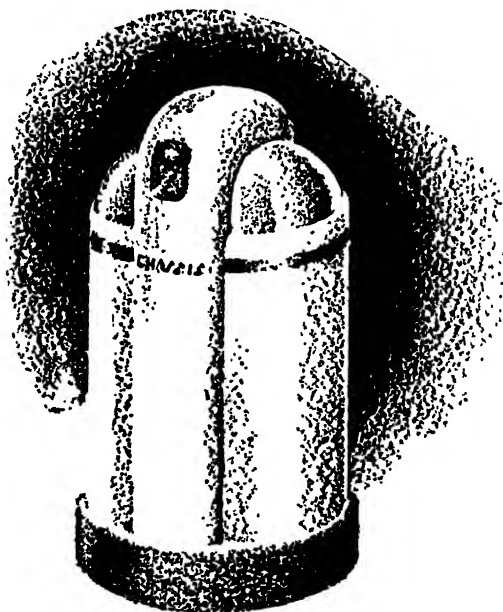


FIG. 88.

with the main circle. When the study model is made to these dimensions, the short arc, x , does not appear concentric at all, but has the appearance of a much larger arc with a longer radius, b . To overcome this tendency for the eye to fly off into

space we shall have to reduce the length of the radius of arc x , making a considerably smaller arc not at all concentric with the main circle. When this is done and translated into clay in the study model, another optical illusion appears, for the arc

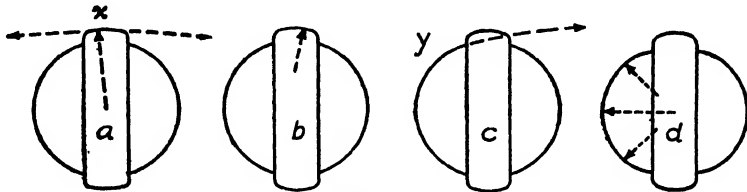


FIG. 89.

of the main circle y also appears to fly off at a tangent, looking to the eye like c . To counteract this, we shall have to make each of the partial sectors of the main circle compound curves, composed of three separate arcs, d .

When this change is made in the clay model, we discover that we have completely destroyed the domelike hemisphere,

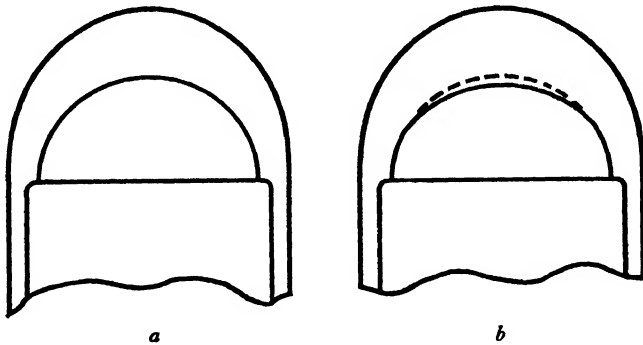


FIG. 90.

because we have cut away part of it in order to alter the main cylinder of the cabinet. Furthermore another illusion similar to that mentioned above occurs in the case of the dome, if, in side elevation, we retain a segment of a perfect circle (Fig. 90a). The interruption of the spherical form by the band, plus the "pull" of the elliptical line above it, leads the eye to believe that it is not a true sphere, but a slightly pointed shape. Again we shall

have to correct this by flattening out the arc, producing another compound curve, *b*.

When we have finished, we find that we have no purely geometrical forms left, but the general effect is rather geometrical. The optical illusions have been overcome, and in the process the design has become more subtle and more alive.

At this point the cost-minded reader will object that the die expense involved in such a design would probably prove prohibitive. It obviously will involve more difficult work to carve out steel to produce these subtle, almost freehand curvatures, than to proceed with the original cylinder-and-sphere design. I

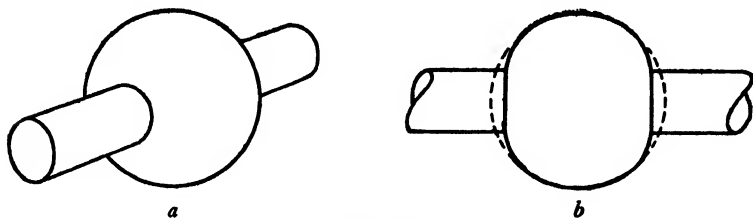


FIG. 91.

can only reply that this is a cabinet of our design already in production, and that the client insisted that the refinements be made even in the face of greater initial tool expense.

SPHERICAL FORMS

Designs involving a free-standing sphere may be equally perverse. As we have seen, the sphere is the most perfect and self-sufficient of all geometrical shapes. But it has a way, if truncated or penetrated by another form, of losing its character and tending to become either elliptical or flattened. To make it appear geometrical, it may be necessary to indulge in some subtle modifications. In Fig. 91*a* a sphere is penetrated by a cylinder. If the cylinder were much smaller in diameter than it is, the sphere would retain its shape without modification being necessary. But if the sketch were before you, in three dimensions, it would readily be seen that the sphere looked slightly ellipsoidal, and corrections would have to be made, *b*.

If we should truncate the sphere to make it into a perfume bottle, a lamp base, or a teapot, we should find similar subtle

modeling necessary to make it look like what it is. For concrete illustration we might take a metal teapot, as in Fig. 92. The design consists of five elements; a drawn-and-spun body; a stamped lid made to fit flush and complete the top of the sphere;

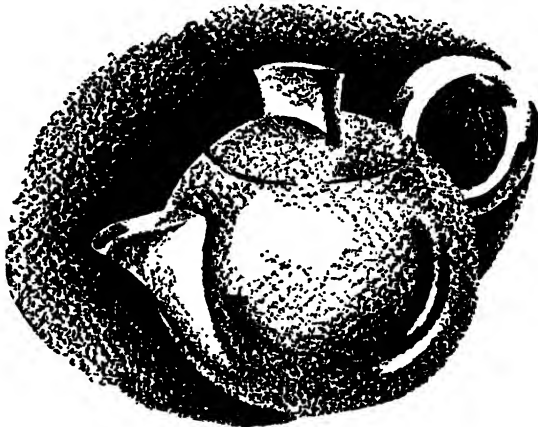


FIG. 92.

a molded plastic handle; a spout welded to the body; and a lid handle or knob.

In laying out the design in side elevation, our first thought would probably be to draw a circle with the compass and cut off a portion of the lower part to form a bottom, as in Fig. 93*a*.

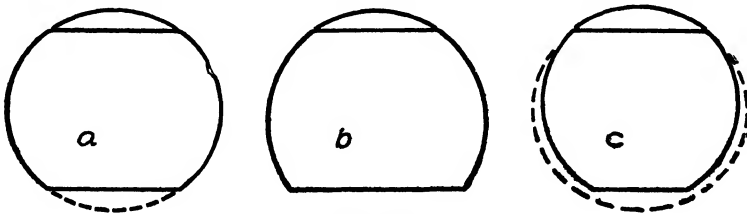


FIG. 93.

This seems perfectly feasible on paper, but in perspective it is another matter. We turn up a sphere in wood on our lathe, cut off a section for it to set on, and discover that it does not look like a sphere at all, but resembles *b*. To correct this illusion we have to shape the model free hand until the effect is spherical,

although the actual form is far from circular. The resultant shape, again showing the side view, is represented by *c*.

If space permitted, illustrations of all of these devices could be multiplied endlessly. Experiment and practice will reveal many more refinements.

It should be obvious that modern design, in its best sense, will not leap full-fledged from the pencil of anyone who can wield a T-square and a compass only. The modern style—misnamed so often “modernistic”—must not be all geometry. Its best practitioners have found, like the Greeks before them, that mathematical regularity creates monotony. The lack of subtlety in much modern work has given it a reputation, sometimes deserved, for being cold and inhuman.

XII · Streamlining

THE SCENE is the office of the vice-president and sales manager of the Peerless Laundry Equipment Corporation. The vice-president is speaking.

"Gentlemen, this is Mr. Blank. He has been engaged by our company to streamline our line of laundry tubs."

Mr. Blank is one of that mysterious yet over-publicized fraternity of industrial designers. He is being introduced to other members of the company: the vice-president in charge of production, the chief engineer, the plant superintendent.

Streamlined laundry tubs! What is poor Blank to say? He knows that the substitution of a few radii or soft curves for angles and sharp edges bears about as much relation to genuine streamlining as knitting sweaters does to the science of hydraulics. But the client calls it streamlining.

Streamlining has taken the modern world by storm. We live in a maelstrom of streamlined trains, refrigerators, and furnaces; streamlined bathing beauties, soda crackers, and facial massages.

True streamlining is not nearly so important, nor so frequently met with in problems of industrial design, as the general public probably thinks. But it is a phenomenon no designer can ignore and no modern book on design can afford not to discuss.

The manufacturer who wants his laundry tubs, his typewriters, or his furnaces streamlined is in reality asking you to modernize them, to find the means for substituting curvilinear forms for rectilinear forms. He wants you to make cast iron and die-cast zinc and plastics and sheet metal conform to the current taste, or fad if you will, for cylinders and spheres or the soft flowing curves of the modern automobile in place of the harsh angles and ungainly shapes of a decade ago.

He expects, too, that unnecessary exposure of mechanical parts will be eliminated, that buttons will be substituted for

levers, and control panels and dials will be organized into simple and easily read groups, tied in wherever possible with related elements of the principal forms.

In ninety-nine cases out of a hundred, this procedure is utterly unrelated to genuine streamlining. Then why does the client refer to it as such? And why should designers be streamlining everything, from lipsticks to locomotives?

Simply because, in the unbelievably rapid growth of the American language, words soon lose their specific and restricted meanings and assume a general significance embracing far wider fields than originally intended. The streamlined laundry tub today means the modern laundry tub. It means the very latest up-to-the-minute laundry tub that can be bought, something so ultra-advanced that it is almost more of the future than the present.

In our rapidly shifting language the life of such words, at least in their popular form, is often brief. The vogue for "streamlining" dates from about 1934. And yet the Oxford Dictionary, that ultimate authority on the history of English words, tells us that it first appeared in print as a term in hydrodynamics in 1873. In 1906 some anonymous engineer described it as follows: "A 'line of motion' or 'streamline' is defined to be a line drawn from point to point so that its direction is everywhere that of the fluid." The word used in the attributive form we know today, "streamlined," saw the light of day for the first time in 1909. Motor manufacturers trying to characterize the increasingly sweeping lines of their cars used the word in this sense soon after. I distinctly remember as a boy having a small friend boast to me that his father had bought a "streamlined" Hudson. It was a touring car, and for the first time a manufacturer had built an automobile in which the lines of the sides swept from hood to rear without the interruption of projecting seat backs.

But the word didn't take. More than two decades were to pass before "streamliner" became synonymous with the modern railroad train and before manufacturers were to summon their salesmen to a "streamlined convention." Nobody can tell how long its current vogue will last, or when it will subside again to its original and more technical level of meaning (again it is the Oxford Dictionary speaking): "that shape of a solid body

which is calculated to meet with the smallest amount of resistance in passing through the atmosphere."

NONFUNCTIONAL STREAMLINING

Since streamlining in its minor or nonfunctional sense—the substitution of radii and fillets for sharp angles and corners—has become such a factor in modern design, it will be necessary to discuss ways and means of accomplishing these effects. But first you must understand some of the manufacturing processes involved.

If you will refer to Chap. XXIV, under Sheet, Plate, and Strip, you will find tabloid descriptions of the processes of "fabrication," stamping, and spinning. Fabrication limits you to purely geometrical forms. Stamping, on the other hand, permits much greater latitude in the development of what, for want of a better name, we shall call "freehand forms," that is, forms curved in two or more planes at the same time. Fabrication methods cannot produce true streamlined shapes; stamping techniques can. Spinning is capable of forming sheet metal with a freehand curve in one plane and true circles in a plane at 90° to it.



FIG. 94a.

Various methods of casting and forming metals, plastics, and rubber (sand casting, permanent mold casting, plastic molding, rubber molding)—in fact any of the methods whereby the material takes its form after being introduced in a molten form, or a form which becomes molten or plastic under heat or pressure or both—are also capable of producing true streamlined shapes.

Three typical forms are shown in Fig. 94a, b, and c, each illustrating some of the processes mentioned.

Sketch a has been fabricated. The main part of the form, which might be half of the casing for a water heater, was shaped in rolls. The bead near the top was put in on a small rolling machine equipped with cylindrical dies. The "revealed" edge at the bottom was made in the same manner, being offset just

the thickness of the metal so that a base (not shown) could be fastened to it and produce a flush joint.

It must be pointed out that this form could have been made on a stamping press. If it were stamped, the piece price would probably be less, because hand labor would be largely eliminated, but the die cost would be large. The process used would thus depend entirely on the number of units manufactured. Note carefully that the main body is a half cylinder, *curved in one plane only*, which distinguishes it from a typical stamped form.

Now examine sketch *b*. Let us suppose that it is the base for an electric fan or perhaps a domestic food mixer. It is an imitation of a functional streamlined shape, borrowed from aeronautical practice. This form could not possibly be made by



FIG. 94.

fabrication methods. If made of sheet metal it would have to be stamped. It could also be manufactured by any of the casting or molding processes, but spinning, here, would be impossible.

The next sketch, *c*, shows another genuine streamlined form, the tapered rear end of a headlamp, or the shell of a hair-drying machine for instance. It could be made by spinning, stamping, casting, or molding, but would be impossible to fabricate, in the sense used above, because again it is curved in more than one plane.

Fabricating sheet metal, for all its limitations, offers possibilities that have not been fully exploited. Let us examine a few of the basic shapes that can be made by fabrication methods, and then have a look at a few details.

Figure 95*a* to *d* indicates a few of the directions that might be taken. They are not intended to represent any particular product, being presented as abstract forms only. With a little ingenuity and the proper equipment, any one of them can be fabricated.

Certain subtleties, such as the "peaked" treatment already mentioned, might also be introduced, but it would be well to use this treatment sparingly and only on plane surfaces. You

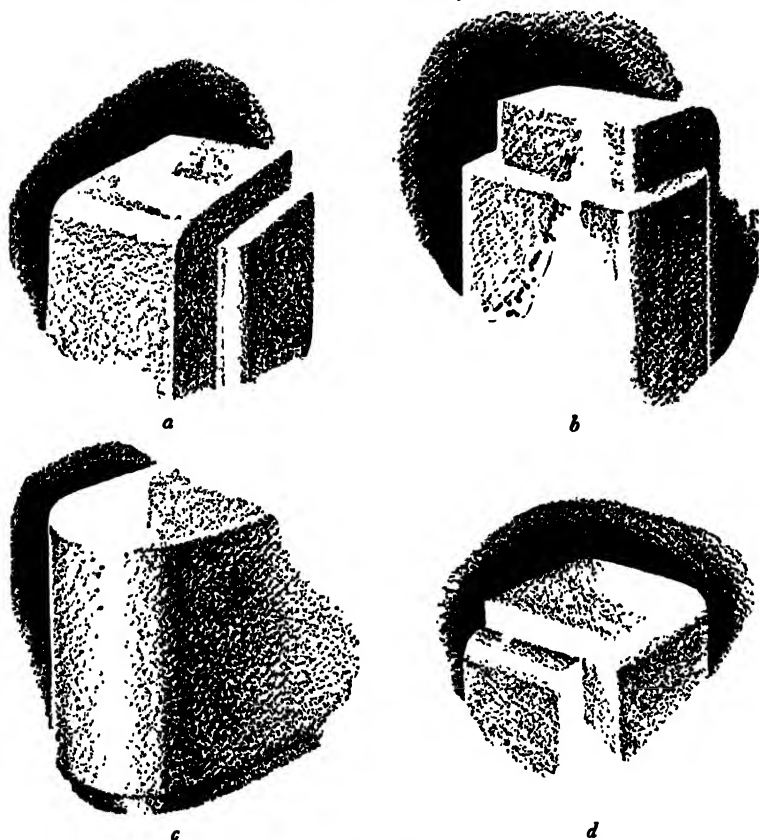


FIG. 95.

cannot push this peak around a curve without changing the technique to stamping.

CORNER TREATMENTS

Now let us look at a few simple corner treatments. Certain types of heating equipment, for example, may call for light sheet-metal casings, squarish in shape. Cost is paramount; volume therefore does not warrant the use of expensive stamping dies. Yet the client wants some evidences of streamlining. Perhaps

the treatment permitted is merely on the corners and edges; a little striping, a few lines of chrome beading, color selection, and a nameplate is all that cost will permit.

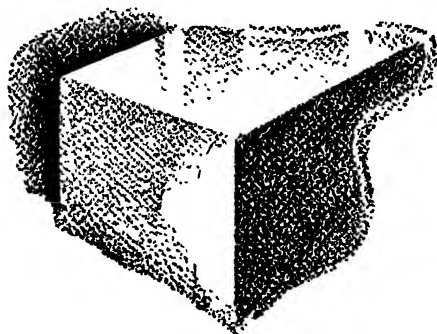


FIG. 96.

What shall we do? There are good and bad ways of rounding edges and of treating corners where three planes meet. In Fig. 96 we see the corner of a small domestic air conditioner treated as the average sheet-metal shop would normally make it if streamlining had not come into the picture. There is nothing

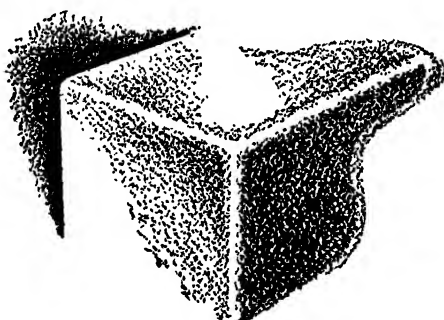


FIG. 97.

wrong aesthetically with a corner like this, *as a form*, but in fabricated metal it has a tendency to make the entire casing look tinny and cheap. Let us see what we can evolve out of this uncompromising geometry.

Our first thought is to put a radius on all three edges, where the planes intersect. This produces a "ball corner," as seen in

Fig. 97. There are several ways of making it, such as notching out the corners and inserting a piece made on small corner dies, then spot-welding it into position; or gas-welding in a corner piece and grinding off the excess metal. As design it is quite all

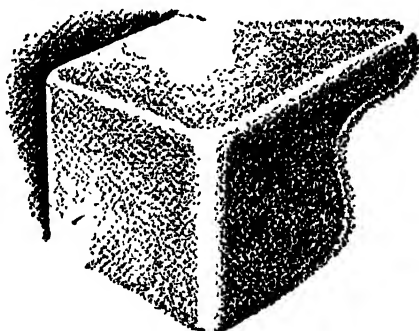


FIG. 98.

right, but not particularly interesting. The trouble is that all of the radii are the same; there is no variety of form.

We can enlarge the radius of the vertical edge only as in Fig. 98. This will help to give character and variety. It creates, however, a somewhat peculiar shape for the corner piece. If the entire

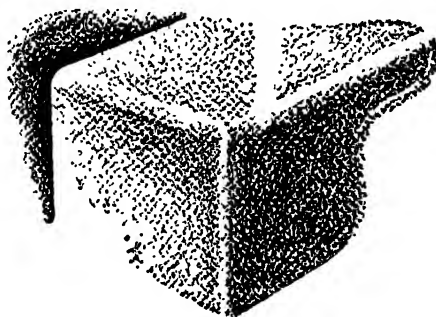


FIG. 99.

top could be a shallow stamping, everything would be well, for, by offsetting the metal on the side-and-front piece with a small roll, we could obtain a flush joint.

Enlarging the radius on the horizontal edges is another alternative as in Fig. 99, but it gets us into trouble. The juncture of a small radius on the vertical edge with two larger ones on the

horizontal plane produces a kind of peak and results in a free-hand, three-dimensional form not particularly pleasant to the eye and difficult to make.

Perhaps we should throw caution to the winds and try something more radical. The limitations of fabrication are such that we cannot dome the top and indulge in any freehand forms. But we can do two things: we can greatly increase the radius of the front edge, producing a soft roll from front to back; or, we can enlarge the radius at each side, again producing a markedly different effect. Refer to Fig. 100*a* and *b*. Both of these would

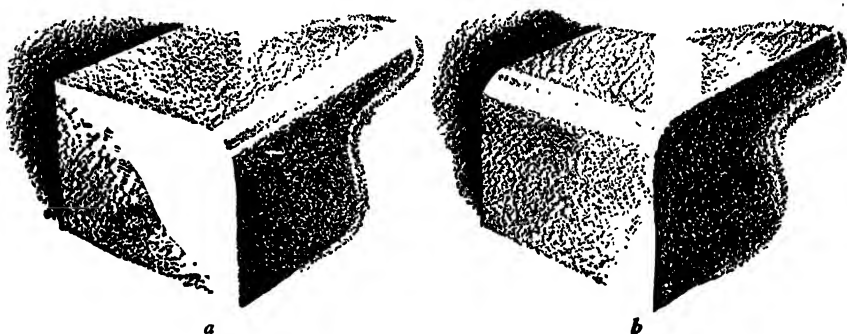


FIG. 100.

require the use of a radius former, unless stamping were resorted to. Which scheme will be chosen depends on the other minor forms involved, the mechanisms inside, and the location of the product in its final installation. The treatment chosen from any of the above suggestions will depend also upon the differences in cost, determined when the cost accountants have had their innings and each operation has been broken down and analyzed to the last penny.

The chief purpose of this demonstration is to indicate the *form* possibilities inherent in the simple intersection of three flat planes, manufactured by one of the most limiting of all production methods. Much more intricate designs could be developed by combining fabrication with stamping techniques, or by using die-cast or sand-cast parts to obtain the desired corner forms.

The exact amount of radius that will look best in various combinations can only be determined by modeling them full-

size in relation to the completed product. These forms are easy to draw on paper, of course, but clay modeling or full-size wooden dummies should be built before making final decisions, because the exact amount of curvature of these radii may mean the difference between something distinctive and something commonplace. If you use two different radii, make them definitely different, not almost alike. (Compare also Chap. X.)

True streamlined forms can never be decided on paper. Here modeling to scale or full size is an absolute essential to success. Work from the start in three dimensions. I do not mean to say that sketching with the pencil should be abandoned entirely, but it can never give you a true picture of freehand forms.

FUNCTIONAL STREAMLINING

The real field of true streamlining is transportation, especially the airplane, although it has hydraulic applications as well. In both of these fields it is functional. It has been borrowed in many forms by industry for application to static objects, where its employment is due largely to popular fancy. This is not the place to debate the merits of borrowed streamlining, although if it helps sell merchandise that should go a long way toward justifying its use.

Streamlining for reduction of air resistance had been studied long before the word itself was coined. It is said that Bessemer made some attempts to streamline railroad trains in England about 1850. In 1865, the year the Civil War came to a close, United States Patent 49227 was issued to Samuel L. Calthrop of Roxbury, Mass., for a streamlined train. Calthrop was a Unitarian minister, born in England, who spent most of his life in Syracuse, N. Y. He was a great athlete, the father of modern crew racing in America, and a deep student of the natural sciences. He died in 1917, not very long before the first streamliner took to the rails.

The claims made in the Calthrop patent (Fig. 101) foreshadowed in a startling way practically every principle of modern streamlining, even to articulation of the cars and fairing of undergear. His train had a sharp nose instead of the blunt forward end we expect today, but aeronautic engineers say that

S. R. CALTHROP.
CONSTRUCTION OF RAILWAY TRAINS.

No. 49,227.

Patented Aug. 8, 1866.

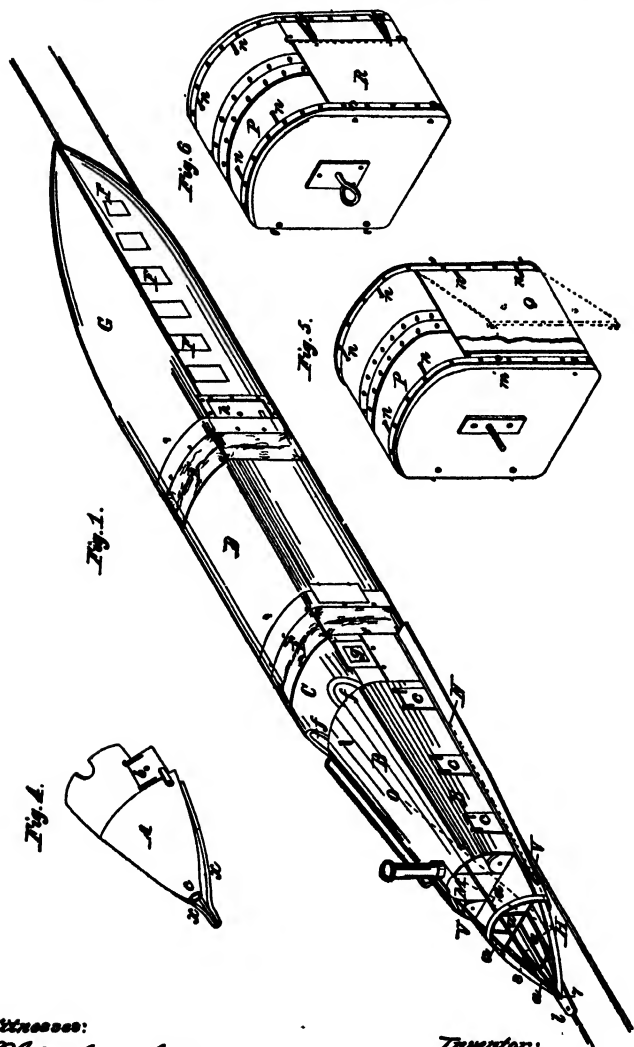


FIG. 101.

Witnesses:
W. W. Blinn
W. W. Blinn

Inventor:
S. R. Calthrop

streamlining at the front is not nearly so important as at the trailing edge.*

In 1890, the Baltimore and Ohio experimented with streamlining on actual runs. But in railroading the streamlining of equipment is largely sales promotion. The modern high-speed, light-weight streamliners owe their speed far more to reduction of weight and installation of roller bearings than to fairing of the locomotive and elimination of protuberances. Actually comparing a four-car streamliner, operating at 115 miles per hour, with a regular eight-car passenger train at 70 miles per hour, the air resistance per ton of train is greater in the streamliner. This does not mean that at these high speeds streamlining is of no value, but economies are not great enough to make it worth while on a long train, especially in cross winds.†

On the other hand, streamlining in automobiles, incompletely realized as it is, increases speed and cuts fuel consumption. Since the power required to overcome air resistances increases as the cube of the speed, really scientific streamlining could increase average speed 60 per cent and reduce gasoline consumption about 40 per cent.‡

The real popularizer of the streamline idea was a genius of the theater, who put his talent and enthusiasm into the visualization of a world of the future, in which everything that moved through water or air or under the sea was somehow manipulated into the shape of a catfish, blunt before, slender and pointed behind. Still under middle age, Norman Bel-Geddes has lived to see buses and trains and some experimental automobiles created by other designers dashing across the continent in forms that are almost Chinese copies of the fantastic sketches he made only a few years before.

* F. K. Kirsten, professor of aeronautics at the University of Washington, says that the shape of the nose of a vehicle does not affect the magnitudes or directions of forces acting on that section because the entry-wedge of air is always pushed up by the entrance of the body into the air. However, the shape of the tail is very important to obtain the least resistance. He criticises modern cars which are well streamlined in front, where it is not needed, and which have short blunt rear ends without the essential double-curvature slim shape. *S. A. E. Journal*, December, 1935.

† "Streamlining Fact and Fancies." By L. K. Sillcox. *Mechanical Engineering*, June, 1936.

‡ *Automotive Industries*, May, 1936.

Streamlining of transportation was bound to come. It was in the air. What Geddes did was to dramatize it, well before it had really arrived, and so convincingly as to crystallize the scattered forces already tending in that direction, and bring reality to a tendency which up to then had consisted of theory and tentative experiment.

BORROWED APPLICATIONS

Inasmuch as this book does not deal with transportation design as such, we shall refer only to the borrowed application of true streamlining to industrial products. In well-nigh its most advanced and complicated form, it may be seen in the design of children's vehicles or "wheel goods" as they are known in the trade: scooters, play automobiles, velocipedes, etc. Its use in this case is surely legitimate, even though air resistance is not a factor, because children like anything that enables them to imitate their elders.

Flashlights and bicycle lamps are often designed as some modification of the two-plane form shown in Fig. 94*c*. Occasionally a manufacturer of metal porch furniture will introduce a streamlined arm rest for the sake of novelty or to "be in the trend." It has also become common practice to put streamlined fenders, reminiscent of the fairing of airplane landing-gear wheels, on small wheels used on movable equipment—even washing-machine castors. This is a harmless if not particularly valuable contribution to sales appeal. Streamlined shapes are sometimes used also for nameplates and trade-marks, as shown in Chap. XXIII. They have become a frequent phenomenon in the design of fans, commercial and household food equipment, and other machines mounted on pedestals. (See Plates 12 and 13 for examples.)

The basic shape from which all of these forms derive is the airfoil section familiar to the aeronautical engineer. It has many variations, long and thin, or blunt and ovoid, like a drop of water falling through the air. By variation of pitch and curvature it may be made to have greater or less lifting power when applied to the wing of a plane; the blunt nose parts the air and the trailing tail allows the slip stream to close behind with the minimum of

turbulence and resultant drag. Figure 102 shows one of many possible sections, in this case symmetrical around the long axis.

If we go back to the dots in Chap. IX, we might find an aesthetic reason for this shape based on rhythm and movement. Suppose we arranged dots in a straight line as in Fig. 103 but made them diminish in spacing by arithmetical progression. Even though the dots are small and all the same size, it somehow gives

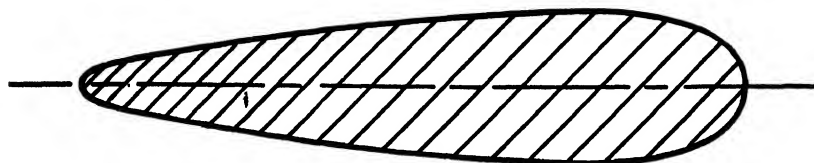


FIG. 102.



FIG. 103.



FIG. 104.



FIG. 105.

us an impression of speed. Convert this into sound by rapping with your knuckles on the table, each rap coming twice as soon as the last.

Now a musician, playing a piece of music which called for this rapid *accelerando*, would also tend to increase the *volume* of sound as the beats come faster. A graphic representation of this combination of acceleration and loudness would suggest that we increase the *size* of each dot progressively, as in Fig. 104.

The suggestion of forward motion, of speed, is thus heightened. If we were to throw around this an enclosing line, as in Fig. 105, it would suggest the airfoil section. Whether or not this exercise

has any basic connection with the shape that makes it possible for an Atlantic salmon to swim with such lightning speed, or an airplane to attain about two-thirds of the speed of sound, I shall leave it to students of comparative aesthetics to decide.

THE AIRFOIL SOLID

The airfoil section spun around on its long axis, Fig. 106*a*, produces the solid in Fig. 106*b*. It will be noticed that it is quite

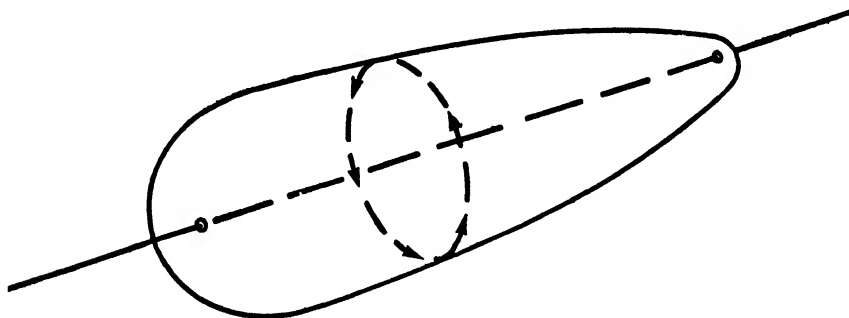


FIG. 106*a*.



FIG. 106*b*.

different from the basic geometrical solids shown in Fig. 26, although it combines elements of both ellipsoid and cone.

If we slice this solid in two at any point at all, providing the line of cut is parallel to the long axis, we shall obtain streamlined shapes varying in outline but analogous to the parent form. Figure 107, for instance, shows that we have produced a form similar to Fig. 94*b*.



FIG. 107.

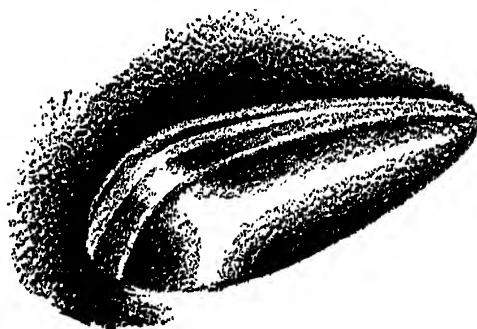


FIG. 108.

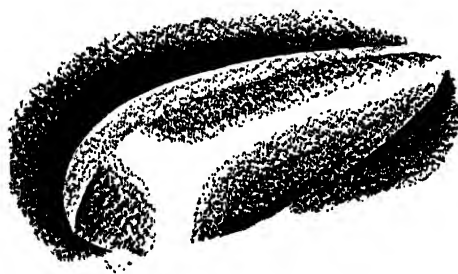


FIG. 109.

Variations of many kinds might be developed from this shape. A band could be superimposed over it, as in Fig. 108. Interesting variety would be obtained by bringing it to a slight peak in the center, as in Fig. 109. Ribs or flutes might be added, as in Fig. 110.

If Fig. 106*b* were cut exactly in two it would suggest the front fender of a modern automobile, although many freehand varia-



FIG. 110.

tions would have to be made to adapt it to its special function. The hood of some modern cars is basically this form reversed. In fact, in spite of modern designing, most cars are still streamlined better to run backward than forward because the motor is still in front.

The student will do well to practice modeling such forms in clay, in the abstract. Paper work will do him little good. As he proceeds, many fascinating shapes will develop, each new one leading to others and each suggesting many product design applications.

XIII · Color

A GENUINE delight in that elusive phenomenon called color is inborn. A great colorist is endowed with special talent and temperament, but a knowledge of, and a reasonable appreciation for, color can be acquired from books or in the classroom by anyone with normal eyesight and intelligence. Such knowledge should be part of your working equipment.

Many men have spent their lives trying to reduce color to a system obeying fixed laws. Their findings have been recorded elsewhere. This book is neither the place to discuss color theory in detail nor to advocate any particular system, but the application of color to industrial design problems will receive serious attention both here and in a later chapter.

It would be difficult to date, with any exactness, the beginnings of the bold use of color we know today. Its acceptance was gradual, but by the late 1920's color had become a force to be reckoned with in selling most types of merchandise.

Many factors contributed to the color revival after the World War: increased prosperity, greater leisure, more active competition. As a nation we began to live out of doors to a greater extent and consequently opened our dwellings to more light and air. We imported theatrical groups and dancers from the Slavic countries and the Far East. We became aware of the barbaric coloring in some of the primitive arts.

Color bespeaks a certain aliveness, and we like to think, with the rapid tempo of our modern life, that we, more than past generations, are truly alive. So we have discarded the drab, muddy palette of the Victorians. And I suspect that such deep-seated influences as our general emancipation from the overstrict moral codes of our grandfathers have played a part in making us more receptive to the excitements of strong color.

Color has a respectable scientific background. You should master some of the verifiable facts concerning it and at least one of the many systems aimed at codifying its practical use. The scientific aspects have nowhere been more simply and graphically set forth than in the first two volumes of three *Monographs on Color** published by the research laboratories of the International Printing Ink Corporation.

The trouble with color systems, on the other hand, is that they differ just enough to be confusing, although most of them agree on certain fundamentals. Among modern students of color, Albert H. Munsell, Wilhelm Ostwald, and Faber Birren have developed the most complete and well documented systems. Familiarity with all three would do no harm, but for your practical uses as a designer, a working knowledge of any one of them will suffice. Which system you adopt is for you to decide. A list of books on color will be found in the Bibliography.

Nothing can replace the trained eye, however, in making final color decisions. The designer who has mixed paints on a palette thus has a head start for which all the theory in the world will not compensate.

TERMINOLOGY

Before discussing the relationship of color to three-dimensional design, we must define terms. Up to the present the Munsell system has had the greatest influence on color thinking and standardization. Therefore I shall use his definitions of color terms, adapted by permission from F. G. Cooper's introduction to *The Munsell Book of Color*.

Hue is the first characteristic of a color that the eye detects. It is how we know, for instance, that a red is red and not green or any other color. Hue is therefore the common name of any particular color.

Value, or the lightness or darkness of color in relation to the scale of gray, is the second color characteristic. When we speak of *dark red* or *light blue*, we are referring to its *value*.

The third characteristic is *chroma*. It refers to the *strength* or *intensity* of a color. Two colors may be the same in hue (both

* *Three Monographs on Color*. Vol. 1: Color Chemistry; Vol. 2: Color as Light; Vol. 3: Color in Use. The Research Laboratories of the International Printing Ink Corporation and Subsidiary Companies, New York, 1935.

red) and the same in value (that is, neither is lighter nor darker than the other) and yet be different in chroma. One may be a strong red and the other a weak, grayish red. To repeat: *Hue* is the *name* of a color; *value* is the amount of *light* in a color; *chroma* is the degree of *strength* in a color.

Several additional terms will be used:

Tint is the color evoked when looking at the mixture of a chromatic (colored) pigment and a white pigment, or when small amounts of a pigment or dye are applied to a white paper or white cloth surface. A *tint* is therefore a color of *light* value.

Shade is the color evoked when looking at the mixture of a chromatic pigment with a black pigment, or the appearance of that portion of a surface which lies in shadow. Therefore a *shade* is a color of *dark* value.

Most color writers, as an aid to orderly thinking, arrange the colors of the spectrum in the form of a wheel or circle. Systems vary somewhat in the number of principal and secondary (or intermediate) hues, but the general arrangement is alike. The Munsell system uses five principal hues and five intermediates. If you will draw a circle with your compass and mark the circumference off into ten equal parts, then, beginning at the top center, write the following names clockwise around the circle, you will have the Munsell color wheel: *red*, yellow-red (orange), *yellow*, green-yellow, *green*, blue-green, *blue*, purple-blue (blue-violet), *purple*, red-purple, and back to red again. Hues printed in italics are the principal ones, the others are intermediates; parentheses indicate alternate names. This will be necessary to an understanding of the next terms on our list.

Complementary hues: two hues that differ most radically from each other. Thus on the Munsell wheel, red and blue-green are opposite and hence complementary to each other. The same is true of purple and green-yellow, or blue and yellow-red (orange). Complementary colors each heighten the intensity of the other when used side by side but *not* mixed. The colorist therefore speaks of the harmony of complementaries, as well as of the harmony of similar or associated colors.

Warm and cool colors: Warm hues are the red-purples, reds, yellow-reds (oranges), and yellows. Opposite them on the color wheel are the greens, blue-greens, blues, and purple-blues (blue-violets); these are the cool hues.

Advancing and receding colors: The warm hues are called "advancing" colors because of their tendency to seem nearer to the eye than their opposites when used in the same value and chroma; the cool colors are called "receding" hues.

PERSONAL COLOR PREFERENCES

The average person, although he may know little and care less about the science of color, acquires certain color associations by the time he reaches maturity. He absorbs most of these impressions during childhood and they stay with him through life unless he makes a conscious effort to change them by study. Therefore it is more important for the designer to understand color psychology than color science. As Faber Birren says, ". . . the average color problem is a matter of psychological and visual judgment and is more concerned with the result of stimulation than with the nature of light itself."

By the use of your knowledge of advancing and receding colors, of the properties of value and chroma, and of warm and cool colors, you can transmit certain definite color suggestions to the emotions through the eye. You can make it look larger and heavier, or smaller and lighter. You can tell the customer that it is expensive, dramatic, dignified, cool, warm, or clean.

Some of the average man's color associations are the result of tradition, others are pure folklore. Some have their origin in scientific fact. Thus red is associated with heat and becomes the symbol for danger, excitement, or passion. Being one of the "warm" colors, it has one of the highest wave frequencies. But green for "safety" is a purely arbitrary association. Since it is one of the most common colors in nature it is also associated in our minds with growth. It was probably chosen for railroading and traffic chiefly because it is the opposite or complementary of red.

We generally accept black as a symbol for death, although in France the trappings of a funeral are purple and in China, white. To us, white, quite logically, suggests purity, cleanliness, sanitation. It has become almost the rule in kitchen equipment, bathrooms, hospital operating rooms, and retail stores where food is handled.

Many attempts have been made to tag all of the spectral hues with associated emotions. These succeed chiefly in express-

ing only one person's reactions to color and should not be relied upon. The "blue for innocence" kind of thing has no basis in fact. Blue is commonly used, however, to mean "discouragement" or "melancholy," a mood connotation which has a certain logic. In the elaborate but arbitrary color symbolism of the Catholic church, blue is the color for the Virgin Mary.

Many people have strong color likes and dislikes. They "love" green or "hate" purple. You can usually depend on it that this is a purely subjective reaction. There are no intrinsically bad colors. A color is bad only if it is inappropriate, or if it is used in combination with other colors that make it inharmonious.

It seems to be generally believed that women are hostile to red. Yet a recent survey reveals that 44 per cent of men give blue as their first choice and 42 per cent of women give red.

Working with a certain company on a large line of toilet-goods items, we made actual-size models in wood for presentation, painting them various colors. All models we happened to paint red were rejected by the vice-president in charge of sales. We did not connect this with the color until a friend in the firm's experimental department tipped us off that the vice-president had a phobia against red. Weeks later we sneaked some of them back painted a tint of blue-green and the designs were accepted!

The client must be persuaded not to let the captious color preferences of any one person jeopardize the success of a product. It is true that there is no known rule to fit all color problems. However, the designer with a trained eye, after he has analyzed the job to be done, can probably pick the right color scheme with much greater chance of success than anyone else involved. Even his suggestions, however, should be subjected to as much empirical testing in the form of surveys, trial distributions, and polls as the client has the time and the money to pay for.

COLOR CONNOTATION

From this welter of scientific fact, folklore, guesswork, and personal preference, can any hints be sifted out to help avoid fundamental errors in color selection? I believe there can; but such facts must be considered apart from the preferences by industries to be mentioned later.

Size

It is a well-known optical fact that *light* values of color make an object appear larger than *dark* values. A white cube will appear larger than a black cube of the same size at the same distance from the eye. This would be equally true of two identical hats, or lamps, or steamships. As the white is grayed by the addition of small amounts of black and the black lightened with white, they will approach each other in apparent size until, when the shades of gray become identical, the size becomes identical. The same is true of the various values of all other colors, although the influence of the warm (advancing) colors and the cool (receding) colors will have to be taken into account.

If you wish to make a product look larger, then, lighten the value of the color; if you wish it smaller, darken it. Sometimes an exposed motor can be made to blend into the shadow and become less objectionable simply by using a dark shade of gray with a matt or crinkle finish. (Gloss black would catch strong highlights and defeat your purpose.)

Weight

The same holds true of weight (light values seem light in weight, dark values heavy), although in this case the hue makes more difference. The cool colors, pale blues, blue-greens, and blue-violets, and also the pale cool tints of yellow, will give the impression of lightness. The warm colors tend to suggest heaviness.

Strength

Weight and strength are usually associated, and the same rules would apply to both, save that the warm colors of stronger chroma (red, red-yellow, and deep yellow) usually connote strength more than the darker, grayer values. It is worthy of note that the metallic paints and dark blue-grays, which in themselves give the impression of the ferrous metals, are good colors to indicate strength.

Temperature

In suggesting temperature, the indications are obvious: reds, oranges, and yellows in strong chroma for warmth; pale blues,

blue-greens, blue-violets, and whites for coolness. A large soft-drink company dispenses iced bottled drinks from coolers painted a fiery red—a fundamental error in color connotation. The only excuse for red, which also predominates in their advertising, is its tremendous attention value. Red handles for electric ironers will sell, but refrigerators with red trim are almost unheard of. Macy's department store discovered that stoves with blue handles did not sell, but that as soon as red was substituted they began to move rapidly.

White and pale colors repel heat; dark shades absorb it. A metal garden chair painted white will remain comparatively cool in full sunlight, but the same chair painted red will be hot to the touch.

An air-conditioned cafeteria in a factory, painted blue, drove women to putting on sweaters. When the scheme was changed to warm colors, complaints ceased, although the actual temperature remained exactly the same.

Cleanliness

White is obviously the best solution here, but as every color and paper man knows, there are whites and whites. Pure magnesium is closest to being an absolute white—9.7 to 9.9 in a scale wherein 10 represents absolute white; but none of the commercial finishes comes anywhere near it in brilliance. The problem then becomes: what admixture of other tints can be permitted and still have white appear white? As soon as white is modified towards the blue side of the spectrum, it becomes dirty looking, until the blue pigment or dye is strong enough to be recognizable as a distinct blue. For most industrial purposes (unless for some special reason a blue-white is desired), it will be well to vary it towards the warm side by the admixture of yellow and a little red.

The ivories and even the pale warm yellows—perhaps because of their association with foodstuffs such as cream and butter—are also admissible for suggesting sanitation. Pale blues, greens, and violets should be avoided.

Dignity

If this characteristic is to be emphasized, no large areas of strong chroma on the warm side of the circle should be used, unless as accents. Gray would be fundamental in suggesting

dignity, with the grayed tones of blue, violet, and green, and the dark values of red as second choices. A limousine for an elderly lady in a dark blue-gray might have an accent in the form of a fine stripe of bright orange, whereas in a sports roadster, many bright colors in strong contrast would not be out of keeping.

If several colors are used, much depends, of course on the combination. Harmonies obtained by the contrast of complementaries should be avoided. The harmony should be rather of the associated hues, or grayed shades of complementaries such as red-purples and blue-greens.

PREFERENCE BY INDUSTRIES

Certain industries have a tendency to standardize on certain colors. Usually there is some reason for it. Perhaps the colors are fast to light, or easy to apply, or merely traditional. Whatever the reason, you must know about it. Industrial color preferences can sometimes be modified, or even changed outright. If changed, you must have a reason based on sound logic.

Here are a few of many special industrial preferences. Metal office furniture, if not grained to imitate wood, is usually painted a shade of grayed olive green; the pigments are cheap and exceedingly fast to light. Machine tools are all painted dark blue-gray; this color has been chosen as standard by the machine tool builders' trade association. Scooters, velocipedes, and coaster wagons run largely to bright red; the first preference of small children. Meat display cases, meat slicers, and computing scales are almost always white; for sanitary reasons. Bathroom fixtures, kitchen equipment, and washing machines are predominantly white; same reason. Typewriters, duplicators, and other office machines are black; no color matching problem, plus tradition.

It was not always so in these industries. Changes have usually come about through gradual evolution. Retail store equipment used to be painted red in most instances and for a time there was a fad in scales and meat grinders for gold lacquer. Machine tools were painted at the whim of the manufacturer until the conglomeration of hues in factories became absurd.

It is sometimes possible to alter the color habits of an entire industry at a single stroke, if the stroke is made boldly enough.

We designed some service station equipment for a large concern, persuading them to abandon their red and black in favor of white, with red trim and black bases. We reasoned that if the equipment were clean looking to begin with, attendants would have an incentive to keep it clean. Within two years the entire industry followed suit.

When the cast-iron stove was replaced by the more modern sheet-metal variety, the industry went chiefly to white. For a period of four or five years white in turn gave way to a variety of pastel colors, applied with fancy crystal, cloud, and wood-grain effects. This fad finally ran its course, and white again became the overwhelming choice of most women. The same is now true of refrigerators, kitchen cabinets, water heaters (when installed in the kitchen), and home laundry equipment.

The bathroom also had a similar fling at color, with pastel shades from orchid to pink and pale blue being offered for lavatories and bathtubs. Although color has persisted in this field to some degree, sales of white fixtures to the middle income groups still predominate.

Manufacturers often have to take the lead in forming the color preferences of their customers. The public is still timid; witness the fact that in by far the greatest percentage of home interiors, wood trim is painted ivory. It is a "safe" color and will go with almost anything.

Occasionally color and form connotations combined have a striking effect upon public reactions. The box-like shape of the cover for most domestic ironing machines, together with its white finish, reminds so many women of a child's casket that they will have nothing to do with the horizontal type of ironer.

More widespread application of air conditioning, with its clean filtered air, will have a good deal to do in the future with brightness of color, both in home and office. Furnishings are often purchased in dark colors simply because it is a foregone conclusion that these shades, in an atmosphere laden with dust and soot, will be more serviceable.

The automobile industry gives us a clue to many trends in color preference. A study of the Automotive Color Index proves, for instance, that color preferences reflect mass states of mind. During depression years it veers sharply towards the somber

colors such as black and gray, then revives with returning prosperity. Regional preferences also come to light. Conservative New Englanders choose more dark or neutral colors than residents of the West coast.

These regional tendencies are paralleled in other lines. One of the large mail-order houses issues a special catalogue for the South because colors favored in that warmer climate run to more brilliant hues.

COLOR AS DISPLAY

Display experts say that the greatest factors in attracting visual attention are movement, light, and color, in the order named. Animated window displays are so compelling that city ordinances or association rulings often forbid them because they stop traffic. Light is next, and in combination with movement, can be almost irresistible in attracting the eye.

Although the least potent of the three *as display*, color can be made to play an important part in attracting buyers to the point of opening purses. It might naturally be inferred that colors of the strongest chroma would be the most compelling in all cases. If this were true, everything would have to be painted a strong orange-red, the most intense of all colors in wave frequency. On the contrary, products that are most subtle in their color appeal often sell the best.

Large areas of strong color are sometimes so overpowering as to annoy rather than attract. The rods and cones which receive color impressions and transmit them to the brain become fatigued more rapidly when brought in contact with the high-frequency colors. Better effects can be obtained by using colors of strong chroma as accents against broad areas of neutral colors, or with black and white. An example would be the service station equipment mentioned above, where bright red accents on a large area of white proved more compelling than almost equal areas of red and black. It is astonishing how much display effectiveness you can obtain with the restricted palette permitted by a kitchen range or a refrigerator, where colors of strong chroma must be used sparingly. You can accomplish wonders with white + silver (satin chrome or anodized aluminum) + small amounts of color.

Color or a scheme of colors designed *for display* should not be used at the expense of other important color considerations: (1) color effect *when in use*; (2) color effect *at the point of sale*.

The most important of all color considerations, of course, is that the scheme should be appropriate and harmonious when the product is in use in the home, the office, or the factory. A white typewriter might help call the attention of a purchasing agent to some special make of machine but would never find its way into actual use in an office. A gold-lacquered kitchen sink might compel attention in a store window or at a trade show but would be out of place on the salesroom floor.

A FOOTNOTE ON COLOR MEMORY

The human eye is so constructed that it is impossible to match colors from memory. You might do it once by accident but the chances are overwhelmingly against repeating the performance. If your client tells you he can remember a certain color, do not go so far as to call him a liar but do not believe him.

We once had a client who insisted upon painting a domestic heating unit "Packard blue." We asked him to show us the color and he searched through our color plates in a vain endeavor to show what he meant. Several days later he spotted one of the girls in his plant wearing a blue dress and was sure it was "Packard blue." She cut off a small portion from an inside seam and the paint shop mixed a sample batch of lacquer to spray the full-size model.

The client admitted it was not right. Meanwhile we wrote to the Packard Motor Company, and they sent us samples of all the blues they had used for several years past. None even approached the color our client was so sure he "remembered."

The Maerz and Paul *Dictionary of Color*,* a monumental work of classification, shows 7,056 different samples, about the maximum number of variations which can be differentiated by the normal eye unaided. Graduations between colors in these plates are so subtle that it is little wonder the eye cannot retain any exact shade or tint for more than a few seconds at a time.

* *A Dictionary of Color*. By A. Maerz and M. Rea Paul. McGraw-Hill Book Company, Inc., New York, 1930.

Do not make the mistake of underestimating the importance of proper color treatment in preparing your designs for the market. Although the form of a product may be ideal, an unfortunate color connotation may kill its sale. Therefore, learn the vocabulary and technique of color; it must definitely be a part of your background.

Part III · Technique

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XIV · Gathering the Data

A CONTRACT or agreement with the client is signed, and you are ready to begin work. What next? The first step, one of the most important in any design development, is gathering the data and organizing it in such form that it may be used with the least waste motion.

Every design problem is a complex of many factors: sales, engineering, production, costs, competition, tradition. Many other things form a running accompaniment to those main themes, among them such intangibles as the human equation, politics in the plant, and your personal relations with various members of the staff with whom you have to work. At the outset, however, your chief concern must be to get every scrap of information which may contribute to the success of the program. Get it *right*; get it *complete*.

The sources of the information you seek are many. It may be well to outline them before discussing each source in turn.

1. The client.
 - a. Sales department and individual salesmen.
 - b. Engineering and production departments.
 - c. Service department.
 - d. Advertising department.
2. The product itself.
3. The point of sale.
 - a. The retail store (for consumer merchandise).
 - b. The jobber, or manufacturer's representative (for commercial equipment and capital goods).
4. The user.
5. The key buyer.
6. The trade show.
7. The trade publication.

All of these sources must be tapped to obtain a complete picture of the problems involved in designing any major piece of merchandise. Ask questions—thousands of them. Take copious notes; but if you have a good memory, you need not assume the air of a newspaper reporter, thereby making the business of note-taking too ostentatious. Ferret out the whole story of the particular product you are about to design. And, always get more information than you need, rather than less.

1. THE CLIENT

The client will naturally be your most productive source of information. Most manufacturers can put at your disposal a vast reservoir of facts about their products. Nevertheless, in using outside design help the company executive is prone to forget that his particular field may not be so familiar to you as it is to him, taking it for granted that you have more background than you actually have. It is therefore part of your job to know what to ask for.

Of course large concerns like General Motors, General Electric, Westinghouse, and Sears Roebuck maintain staffs of consumer research men who are constantly submitting questionnaires to the buying public, tabulating their likes and dislikes, and putting them in order for the guidance of their engineering and design departments. Smaller concerns, too, through the reports of their salesmen, jobbers, and service men, have a pretty accurate picture of the virtues and defects of their merchandise and of what the public really wants.

Interviewing sales and production departments will take most of your time; but the service department must not be neglected. From advertising men you will get that emphasis on the telling phrase, the eye-catching feature, which will help you to design for sales.

a. The Sales Department

There are several kinds of information you must secure from Sales: the history of the product; the type of sales outlet; present and past quotas and future sales expectations; other products included in the line.

Product history is important. It may surprise you what real romance often lurks in the early development of the most prosaic product, and how some seemingly unimportant fact may turn out to be the clue to a valuable contribution that you, as designer, can make. The product's evolution, in a sense, sets the stage for the whole development program, and a thorough understanding of it may save you from repeating earlier forms and making false moves.

For example, the Maytag Company, at the turn of the century, was engaged in the manufacture of various types of farm machinery. A certain part of one of their models caused considerable trouble and complaints poured in from farms in the Middle West, which formed most of their original market.

There was one area, however, from which few if any complaints ever came. F. L. Maytag, the president, on a swing around the territory, dropped in at the store of the dealer who covered this particular region. There he met a young service man, Howard Snyder by name, who liked to fool with machinery and "fix things up." Snyder admitted that the Maytag machines required service, but stated that he had repaired them without difficulty and without reporting any of his troubles to the factory. Maytag found that the young service man liked to tinker with all types of machines and, impressed with his ability, offered him a job. The offer was refused. A few years later, after a couple of bad seasons, Snyder found himself without a job. He came to Mr. Maytag for the position offered two years before—and got it.

Soon after Snyder joined the company, Maytag put a conventional hand-powered washing machine on the market. When washing machines were first produced in large numbers, they were largely of the "dolly" type. The dolly was a round wooden disk with four pegs projecting below. These pegs dragged the clothes to and fro through the water. Later, cylinder washers employing a tumbling principle were widely manufactured. The Maytag Company, along with others, built both types.

Mr. Maytag always felt that a better washing principle could be developed. Again and again he said that he wanted a better washer. Finally Snyder came to him and said, "I've got it." Shortly before Maytag had put the cylinder type on the market, Snyder had developed a square cast-aluminum tub with a cone-

shaped bottom. This tub, however, was all but forgotten while the cylinder model, which used a tumbling principle, was being prepared for the market. What Snyder had done was put an oscillating disk with upward projecting vanes in the bottom of his cone-shaped tub so that water was thrown through the clothes and they were washed white while in suspension. Thus the principle of underwater agitation was born.

After a long period of experimentation the new washer was placed on the market, and in less than three years the Maytag Company leaped from an obscure position to become the giant of the industry.

The new washer was the invention of the farm lad with a knack for "fixing things up." Thus F. L. Maytag's chance visit to one of his dealers' stores has influenced the work of many engineers and designers because the modern washing machine has changed from unwieldy tanks with revolving drums and from oscillating "milk stools" in the lid, to a simple tub on legs.

The typewriter has had a curious evolution. Three principles fought for supremacy: (1) the type was thrust up vertically, from beneath, against a revolving platen; (2) the type was embossed on a small drum which, upon pressure from the key, revolved until it stopped at the proper letter, then descended to strike the platen; (3) the type was levered forward like a sledge, striking the platen in full view of the eye. The third principle won out, although the revolving-drum principle is still used on one machine which holds an honored place because, by merely changing the drum, the style of type and even the whole alphabet can be changed quickly and cheaply. The key bank used to be much larger before the shift key was introduced, but in general the key bank and the revolving platen were substantially the same in all of these machines. But the different principles involved in impressing the type on the paper created radical differences in appearance.

History often gives a background upon which to base your design thinking. The dial type of gasoline pump is entirely different from the old gravity pump, hand operated. From dustpan to carpet sweeper to modern vacuum cleaner is a far cry, too.

Learn next what your client's sales outlets are: whether the product is sold through jobbers, retail stores, company dealers,

house-to-house canvassing, or by whatever other means, direct or indirect, it is brought to its ultimate user. This has a vital bearing on design. A vacuum sweeper sold only from house to house actually does not need eye appeal so much as a sweeper that first greets its potential purchaser in the display window or on the floor of the department store. Why? Because in doorbell selling, once the housewife lets the salesman get into the house to give his demonstration, he can talk so fast about function and efficiency that his prospect never gives a thought to appearance. Appearance, on the other hand, is a strong force in attracting the woman who started out on her shopping tour without even the faintest notion of looking at sweepers.

A classic example of designing for point-of-sale adaptability is the Toledo Sentinel scale. Toledo is the oldest and largest manufacturer in the country of automatic weighing machines. One model in their line was a retail-store scale. It was a standard for accuracy and durability, but it weighed 165 pounds. Now the best way to sell commercial equipment is to demonstrate it in the merchant's store, but there are few salesmen husky enough to tote 165 pounds of cast iron into markets a dozen times a day. In the picturesque language of the company's president, "By the time a salesman was good enough to sell it, he was too old to carry it."

The result was that the salesman would show pictures of the scale to his prospect, then try to persuade him to visit the company's local display rooms. But the busy merchant, waiting on his own customers twelve hours a day and concerned with his own business, usually had neither time nor inclination to make the effort.

A fundamental program of redesign was therefore begun. There were two primary objectives: (1) to reduce weight drastically and (2) to reduce size and bulk, by placing the computing cylinder at such a height that the merchant could face the customer across the counter without the scale's obstructing his view. It took seven years, and it led engineers, metallurgists, chemists, and designers an exhausting chase through many devious bypaths, even to the creation of a new plastic material for the housing. At times it seemed like the quest for the elusive pot of gold. But at the end of the rainbow was a scale weighing 57

pounds, which could be carried like a suitcase and permitted the customer to see his pork chops as they were being weighed.

In redesigning the scale two major improvements were made into the bargain. The new machine, through an ingenious group of magnifying lenses, gave the dealer twice as many price computations on the same cylinder diameter; and the new plastic material provided a gleaming white housing which would not chip like porcelain enamel. (See Plate 18.)

With a product sold in a department store, on the other hand, the problem of weight would be of little importance. Actually you are often asked to give at least the illusion of greater weight and bulk so that the customer will feel that he is "getting his money's worth."

At first thought sales quotas may not seem to have much bearing on design. On the contrary, they are of great importance, for they give you the clue to the type of production equipment you will have to deal with. Small quantity production may call for "fabrication" methods, whereas, with larger quantities, stampings would be in order. The type of design treatment would then be entirely different.

Likewise, if you are designing a plastic molded piece, and the anticipated quantity indicates, let us say, a single-cavity mold, handwork on the dies will be considerable and the expense correspondingly large. But if a 12-cavity mold is in the wood because of large quantities, a hardened steel hob will be made; each of the cavities impressed into the steel mold block with this hob will amount, per cavity, to but a fraction of the cost of the single mold. The smart designer, in working out a design for single-cavity production, will try to make the form as simple as possible in order to cut down die cost. But with the 12-cavity mold he can go the limit, for once the hob is made, multiplying cavities is a comparatively inexpensive matter.

There is always a certain point where expensive tools and dies will be cheaper in the end. That point can be mathematically determined by figuring the amortization of a known tool-and-die cost over a given volume of production.

Do not forget, also, to familiarize yourself with other items in your client's line. If he makes toasters, he probably makes griddles, roasters, and electric irons too. Even though you are

engaged to restyle the toaster only, you would be remiss if you did not acquaint yourself with the rest of his products. His business must become your business also. You are, for the time being, a member of his official family.

Although the sales manager and his assistants will provide you with most of the sales information you need, you should not neglect, at some time during the course of your work, to interview individual salesmen too. Find out what their problems are, how they tell their story to the prospect, what features they are stressing, and what kinds of resistance they encounter. It would be a liberal education to join forces with one of the company's picked salesmen, watch him at work, and study the reactions of customers to the product he is trying to sell.

b. Engineering and Production Departments

When you feel that you have product history and sales background well in mind, someone in the engineering department familiar with the product should be drafted to give you a thorough lecture on its construction. Take the machine or device apart with him as your guide; find out what materials go into each part, and how each part is made.

Be persistent. Don't be afraid to show ignorance of what, to your mentor, may be as plain as the nose on his face. Stay with it until you understand it. Most intelligent engineers like nothing better than to analyze the children of their brain, to point with pride to the obvious superiorities in their creations. They will respect you more if you are thorough and if you pass over nothing in your endeavor to grasp the operations completely.

At this stage of the game, be careful of criticism, be sincere with praise. The product may be pretty homely, but don't indulge in wisecracks about it. Remember that the men you are talking to may be inordinately proud of their work, and, being only human, will respond to appreciation and resent unjust criticism no matter how well intentioned. This may be the most critical point in the success or failure of your relations with that client. If you can make a friend of the engineering department by a sympathetic attitude and a little judicious back-patting, your battle will be half won. But if antagonism rears its head at this juncture, the future may be dark indeed, for although the resistance may be

passive, it will be none the less real. I am not advocating indiscriminate bootlicking; merely the application of common-sense diplomacy in bringing the engineers over to your side.

Do not hesitate, at this point, to lay your own cards on the table. Tell the engineers how you go about your part of the work, first familiarizing yourself with the market, then gradually developing the project through various stages: rough visualizations in both two and three dimensions, plaster models, and mechanical drawings. Tell them frankly that you have much to learn, but that you intend to cooperate in every way. Make them understand that you are just as anxious as they are to arrive at a design that can be built at a cost permitting a profit.

Engineers are purported to be resentful of industrial designers. I have found them cooperative and only too happy to receive help in a phase of design with which they have never concerned themselves deeply. If you can get the engineers working with you, you will be surprised how their ingenuity will make the work develop and grow.

On your first visit try to get a full set of blueprints to take back with you. Check these over carefully with the engineers at the plant and see that you have the assemblies, subassemblies, and all details complete. While you are studying the product itself, have the prints at hand, and refer to them so that you visualize each part as you go along. If recent changes have been made, or are about to be made, get the engineers to indicate what they are on the prints. As you become experienced you may frequently have possible variations of the design come to you while you are studying the old product, and by adroit questioning you can find out at this first meeting just what alterations in arrangement of the mechanism might be permitted without, so to speak, showing your hand.

There have been occasions, rare I admit, when I have been able to visualize the general scheme of a new design at the very first meeting, and have had the final manufactured product come pretty close to that original conception, which had no reality except in my mind's eye. It enabled me to ask at the outset such questions as, "Can the motor be mounted vertically instead of horizontally?" "Would you consider a stamping in place of a casting for the base?"

It is sometimes astonishing how difficult it is to get complete and up-to-date drawings on a product. I know of one large company, undisputed leader in its field, whose drawing files on their product are woefully incomplete. Another company had been making a small device without change for so many years that there were no drawings at all; we had to take it apart, scale off every part separately, and make our own set of drawings before we could begin work. This particular product even had the name of another company cast on the handle, a company which had originally been the exclusive distributor for the product. Although our client had not sold it through this outlet for years, the name was still on the patterns, not for any psychological sales reason, but simply because nobody had bothered to remove it.

Still another company makes all details and subassemblies full or half size, but their assembly drawings are made to two-fifths scale. They are provided chiefly for service men in the field, where actual proportions are not important, but the outlandish scale causes no end of trouble to the designer.

Sometimes a design may be successful as much through its adroit handling of detail as by its relative proportion of masses. One of the most important matters in many products is that of product "identification," of treatment of name plates, instructions for operation, and the necessary patent numbers, serial numbers, and inspection data. Although this subject will be discussed at length in Chap. XXIII, let me warn you here to obtain all information at the outset. A last-minute scramble to include it in your design may be disastrous.

Certain industries are subject to special regulations and legal requirements. Good electrical equipment must be approved by the Underwriters Laboratories. You should ask for all such information that will affect design. Scales, pumps handling various liquids, and conveying equipment are subject to both federal and state regulations by weights and measures authorities. These regulations may be different for different states. Gas appliances must pass certain tests by the American Gas Association's Laboratories; structural equipment may have to be inspected to meet local, county, and state ordinances. Try to obtain such information at the beginning; it will save trouble later on.

When you have obtained all the information that you need from the engineering department, it is time for a tour of the plant. Perhaps one of the engineers will take you through, or the plant superintendent, or perhaps a man especially detailed to such duties. Do as thorough a job as you possibly can. If the manufacturing process involves many steps, several trips on successive days may be required; perhaps certain departments are not operating, or perhaps there is a series of presses running different stampings on different days. The terrific din in many plants makes it particularly difficult to get explanations straight, and too often there is a tendency to let certain details slip because of the physical strain of conversation.

Much, also, depends on your guide. He may be too superficial, taking it for granted, because a certain process is plain as day to him, that you will grasp it without effort. Insist on following each step through in its logical order, and be sure that you understand each problem in turn.

There are few plants today that are self-sufficient, manufacturing all the various parts that go to make up the product. Many, of course, are little more than assembly plants. Some have stamping presses but depend on outside foundries for their castings; others use a number of die castings but buy them from an outside source. So it is manifestly impossible to follow your product "from mine to freight-car door." But once you are familiar with the various processes by which parts are made, you can fill in the gaps without too much difficulty and form a pretty complete picture of the entire manufacturing setup.

Assembly is of critical importance; this procedure is almost sure to be carried out in the main plant. I have seen clever designs, each component part of which was thoroughly practical to make, that could not be built simply because the parts would not go together in practical and logical sequence.

Assembly, in fact, is one of the points in the manufacturing process where the intelligent designer may be able to effect real manufacturing economies. Labor is usually the big cost factor in a product made up of many separate parts. Even though the most modern equipment is used, with every effort to avoid hand operations, the parts will not go together by themselves. For

certain operations there is simply no substitute as yet for the human hand and eye.

What you are permitted to do with some designs may be limited by the client's equipment. You may wish to make the side panel of a display cabinet in the form of a stamping ten feet long, but you find that his largest stamping press will accommodate only an eight-foot blank, and he does not feel justified in spending \$25,000 for a new press. Perhaps you would like to make a certain part by die-casting, but this client has a well-equipped iron foundry; his production is limited enough so that it pays him to keep his foundry busy, rather than pay for dies and have the part made outside. If the element is much in evidence, the softer filleted treatment necessary for a sand casting may affect the entire treatment of the rest of the design.

c. Service Department

Sometimes neglected, but often the source of much valuable information, is the service department, the department that is always ready to give tangible evidence, in the form of repairs, of the company's desire to give continuous and trouble-free service with its products. If the service department has had a run of complaints from users regarding some feature of the product, it is up to the engineers and the designer collaborating with them to see that the next model corrects the fault. A well-organized service department tabulates the frequency of complaints, thus providing clues of substantial importance.

d. Advertising Department

The advertising department, as well as the company's advertising agency if they employ one, will have file after file of market analyses. They will also have plenty of ideas about what is wanted in a product, ideas gleaned from the field and from a study of the public's reaction to the product. Sometimes, it must be admitted, the enthusiasm of the typical advertising man may carry him away and his suggestions will be impractical. It is well to check with others before spending too much time working on a brain storm which, for many reasons, would not prove feasible.

Before you leave the plant, you should equip yourself with catalogues, folders, and photographs of the product, everything of a pictorial nature that you can lay your hands on. Cutaway or phantom views are useful for reference, and are often to be found in sales and service literature. The advertising department is likely to have in its files many photographs which have been used for advertising; a selection of these, especially the ones that show unusual views of the product, are worth having. If the product is made in a number of different sizes, be sure that you have a chart showing variations in proportion, for, although the designer usually does his preliminary work on the size which is the biggest seller, he must constantly keep the other sizes in mind.

In the case of large machines, such as special machine tools, food machinery, chemical machinery, etc., of the kind built only on order, the client's photographic files are likely to be rather complete. Obtain all possible views from him. Another valuable tool in work of this kind is the candid camera together with a few photo-flash bulbs. The client's photographs are usually taken from normal angles, and are used for catalogues, direct mail pieces, or trade-paper advertising. Often, however, while the machine is on the assembly floor, you can get angle shots with a small camera which will help explain its operation and which, by checking with the blue prints, will clear up uncertain points that might take days to straighten out in correspondence.

It is not a bad idea to have a check list with you to jog your memory. Herewith is a suggestion for such a list:

1. Complete blueprints.
2. Catalogues and brochures.
3. Extra photographs, including cutaway or phantom views.
4. Special small parts.
5. Name plates, patent, and model-number data.
6. Data on underwriters' regulations, special laws, etc.

2. THE PRODUCT ITSELF

The most important item of all has yet to be mentioned—having the product itself constantly at your elbow. In your own offices you can hobnob with that stoker or icebox or electric fan to your heart's content. You can take it apart and put it together again, you can climb over it, or squint at it from every angle,

brooding over its uncompromising angles and ghastly color combinations. In the sanctuary of your own office you will become familiar with its foibles and failings, and try to give it the magic touch that will make it outstrip every competitor in the field.

Your client can hardly expect you to work entirely from photographs and prints, unless, of course, it is a brand-new product for which there is no precedent in his line. He will be glad to ship you a sample on credit memorandum and let you keep it as long as you need it. It may become somewhat shop-worn in your possession through much handling or through building up parts with clay. You may even lose a few gaskets and a bolt or two, but if you do a good job for him, he will forgive you, perhaps even sell you the carcass at a substantial discount when you are through.

But what about machines too large or too costly to send to the designer? What about the automatic bottle washer that weighs two and a half tons, is made of solid cast iron and sheet steel, and sells for \$6,000 cash? What about the automobile lifts which you are asked to "style," and which take up the space of half a dozen tables in your drafting room?

Many is the time we have unhung doors to get a half-ton machine into the front office, hired a crew of laymen to carry up the stairs a gasoline pump which the delivery truckmen, believing we were an oil company and would be, literally, "on the level," refused to take beyond the ground floor. We have even hired a crew of piano movers and removed windows from the drafting room to get a refrigerator into position so we could study it first-hand.

But with larger machines you must content yourself with drawings, or study them in places where installations have been made. This often takes time and effort and there may be only certain hours of the day when such study is practical. If possible, persuade your client to give you a "clearance model," described in Chap. XVII. In many cases this will serve almost as well as having the full-sized machine in your possession, and, together with a complete set of prints, it should give you most of the information you need—unless, of course, the machine is undergoing a mechanical overhauling concurrent with the appearance design.

3. THE POINT OF SALE

a. The Retail Store

Intelligent shopping in retail stores is such an essential part of your routine, that it hardly seems necessary to mention it. You go shopping at the point of retail sale; you put yourself in the position of a prospective purchaser and get the salesman on the floor to give you a sales talk. In this way you study competitor's products as well as your client's. Many times the clue to a competitor's success may be found in the enthusiasm of salesmen for some particular feature which your client's product does not have. Statistics and surveys will mean absolutely nothing when you sit down to your drawing board if you don't know what Mr. and Mrs. Average Citizen grow enthusiastic about.

If you have had actual retail selling experience, you possess a decided advantage in designing consumer products. You learn to gauge the reactions of customers, what features interest them, how much or how little they analyze the product they are buying. You know something about the pride of possession. Although women are seldom mechanically inclined, they are intensely practical on the subject of convenience. Ease of operation, labor-saving features, automatic controls, accessibility of various parts, all come within the range of their criticism or praise. I can think of no better training for the industrial designer than a period of retail selling in a department store, especially if he has a chance to work in several different departments.

b. The Jobber or Manufacturer's Representative

Certain types of commercial equipment are sold through jobbers or manufacturer's representatives. The big jobber in the service-station equipment field may have franchises on greasing equipment from one manufacturer, gasoline pumps from another, hoists from another. Since most of such equipment is not readily portable, he cannot carry it from one garage or service station to another. Therefore his customers visit his showrooms, which then become the point of sale.

If your client's equipment is handled in this way, you should get permission to visit some of these jobbers, whose daily con-

tacts with the customer make him a mine of information on matters of convenience, accessibility, and many other selling points. By intelligent questioning you can often obtain a type of information which the manufacturer himself is not in a position to give, except secondhand. The client may think that the jobber demands too much, but a visit to the latter may convince you that certain features of the product really offer just cause for complaint. It may give you the clue to some added convenience feature which will help the jobber sell more merchandise and thus build up volume for the plant.

Capital goods are usually sold either by company salesmen or through manufacturer's representatives who may handle various types of heavy equipment made by different companies. The point of sale in this case is usually the plant manager in the prospect's factory. Such selling, due to the size of the equipment, is usually done from catalogues, supplemented by actual photographs of typical installations. Usually before committing his firm to the point of buying a machine costing many thousands of dollars, the plant manager inspects installations in other places and frequently visits the machinery maker's plant itself to go over the special engineering features in great detail. For you to be "in" on such a sale is seldom possible, but the salesman or the representative may be able to help you with a recital of the difficulties he has had in closing certain deals. If it is convenient, interview as many salesmen as you can, but first get permission from your client.

4. THE USER

Talk to users and owners. Ask them where they would like the switch placed on their ironer, where they keep the milk in the refrigerator, how they think the burners should be grouped on top of the stove.

The user, of course, makes or breaks the reputation of any product or machine. If it gives him trouble-free service, if he is proud to own it, he becomes a two-legged, articulate advertisement for that particular product.

At this juncture let us pause for a moment and ask ourselves just how far the designer should go in investigating the ultimate consumer's reactions to the merchandise he buys. In my con-

sidered opinion any attempt on the designer's part to make an exhaustive "market survey" is sheer folly. I am aware that some designers make this a part of their service and perhaps in some types of product it may be justified. But such a survey requires a special setup, one that is expensive and requires a high degree of skill and experience to carry through successfully.

One large manufacturer told me that his firm had spent many thousands of dollars for a consumer survey made by a designer. When the results were finally presented, handsomely bound, the findings merely corroborated what they already knew. The report had given them, he said, not a hundred dollars' worth of new ideas. Perhaps his estimate of its value was unnecessarily low, for surely corroboration by an outside source is worth something; but unfortunately for the designer the manufacturer did not think so.

Most companies are in a position to know far better than any outsider the virtues and defects of their product and its market acceptance. If they feel the need of a fresh point of view, there are many organizations with trained investigators whose business it is to ring doorbells, and who are infinitely better equipped than the designer to obtain quick and accurate results. Some advertising agencies undertake such surveys also and either type of organization will gladly work with you, giving you the results of their investigations as an aid to design activities.

5. THE KEY BUYER

The buyer—the man who must purchase large quantities of a product for retail outlets—is sometimes a good source of information. He is hardheaded; he knows the game. He likes to be asked his opinion and will be full of suggestions on the features he would like to see in a new model. Since he is not an engineer or production man, his ideas are often impractical, but somewhere in the course of the conversation you may get extremely valuable leads.

He is not, however, to be accepted without question as a source of design inspiration. Take his suggestions with a grain of salt. His store may handle several makes of one type of product. He expects that the best features of all will be incorporated in a single design, without regard for expense or for the (to him)

negligible question of patent rights. And he *always* wants major improvements at a lower price.

6. THE TRADE SHOW

One of the best ways to acquaint yourself quickly with what is being done in any field is to attend that particular industry's trade show. There you can generally see your client's products side by side with those of his competitors in a short time, a panorama that might take months to piece together through arduous "shopping."

Most of these shows are annual affairs, although a few are held twice a year, and some, such as the machine tool show, at irregular intervals, but approximately once every three years. Some are always held in the same city; others move about from year to year.

One example is the automotive accessories and service equipment show, now presented each December at the Navy Pier in Chicago. In this vast exhibition you can see everything from the latest polishing rag to motor analyzers and hydraulic lifts. The housefurnishings show is also held annually, with a smaller conclave at the half-year; it covers practically everything in the housewares and domestic appliance field. The gas equipment convention includes furnaces, ranges, space heaters, unit heaters, and allied equipment, whereas scales, slicers, refrigerators, coffee mills, and such are shown at the annual meeting of the retail grocers' association. Scores of exhibits, large and small, cover practically every field of importance in industry, giving the designer an unparalleled opportunity to steep himself in the background of his client's specialty.

7. THE TRADE PUBLICATION

Trade publications, sometimes devoted exclusively to a single industry, are also excellent sources of information on what is being done and what the trends are. Most such publications have a section devoted to new products and new materials. The designer should be an omnivorous reader of trade publications in special fields that have a bearing on his particular type of account.

CONTACT MEMORANDA

You are almost ready to begin work. There is one thing more to be done, however, no matter how eager you may be to try your luck with the new design. All your preliminary meetings with executives, engineers, and advertising people should be condensed into a preliminary contact report. The client may believe that he thoroughly understands what your procedure is going to be, but it will do no harm to repeat it in the preliminary memorandum. In addition to this, all points that have been especially stressed as important should be clearly and accurately stated. Copies should be sent to everyone present at the meeting and one retained for your own files.

The more concise these memoranda are the better, but they must be complete. No need for literary style, even the style of a good business letter. Use abbreviations wherever possible and make the paragraphs short. List points under *A, B, C*, or *1, 2, 3*, as in the following sample. The form might easily vary but the essential information is there. It is good practice to have these contact memorandum forms printed on a tinted paper, so that they may be easily distinguished from your letterhead in the client's files as well as your own.

Reference MEMO

ARTHUR MARTINDELL, INC.
Industrial Design
CHICAGO, ILLINOIS

October 10, 19—

SUBJECT: Meeting between Messrs. Earle, Camden, Williams, Jones, and Wellington of Cosmic Products Company and Messrs. Martindell and Villette of Arthur Martindell, Inc., in Mr. Earle's office, Philadelphia, October 8, 19—, on new line of Cosmic refrigerators.

At the beginning of the meeting Mr. Camden said sales department would like to have two distinct lines, Special and Standard, in radically different price ranges. Special line: (design and richness to be paramount) to be made in 5, 6, 7, and 8 cubic foot capacities; Standard line: (stripped down) in 4, 5, and 6 cubic feet.

Mr. Wellington pointed out that once dies were built for volume production it would be difficult to make great difference in price on cabinet itself by cheaper methods of construction, without sacrificing quality. Would sales department agree to making differential on hardware and interior accessories? Agreed.

Mr. Earle reviewed history of Cosmic products briefly. High spots: (1) Company originally built compressors, then added commercial refrigeration. Domestic line only four years old, begun in depression years. Patented In-a-Door feature made line take hold in face of well-organized competition. (2) Sales distribution best organized in rural territories. Little national advertising, strong newspaper campaigns. (3) Volume last year, 108,000 units, about 60 per cent Special, 40 per cent Standard.

After discussion, the following points emerged as guide to the designers.

A. CABINET

1. General Proportions. No radical change being considered. Mr. Camden suggested that Martindell, Inc., should not be hampered by present conventional shape, however, but work out any novel ideas for presentation.

2. Dimensions. Mr. Wellington provided specification sheets on all sizes to give basic dimensions of present line. Suggested that Martindell, Inc., make all preliminary studies on 6 cubic foot cabinet.

3. Door. Must project from cabinet more than competitive makes because of In-a-Door feature. Batten strips are made of black Bakelite in sheet form. Possible to eliminate the screws? Cosmic Company working on this, but no success as yet. Door must have 135° swing. Must open either left or right. Temperature indication on outside of door? Possibly on Special line.

4. Base. Might be recessed for toe room, but not essential. Base usually black, but Cosmic willing to consider gray. Air space must be provided.

5. Hardware. Present latch made of brass punchings. Mr. Williams cautioned against complicated latch mechanisms. Possibility of combining plastics and metal discussed. No conclusions. Inside hinge has not proved satisfactory to date, but may be considered. Martindell suggested piano-type hinge.

6. Identification. Cosmic script monogram "C" must be included in design of name plate; word "Cosmic" may also be included.

B. INTERIOR

1. Evaporator. No changes in construction or proportions contemplated. Porcelain finish to be retained. Martindell brought up possible enlargement of evaporator unit across top of food compartment. Possible, but not enthusiastic. Circulation, and baffles to catch drip, the big problem here.

a. *Escutcheon*: Cold control and on-off switch now combined in one. Illuminated or edge-lighted dial would add to cost, but would like to see sketches.

b. *Tray Compartment Door*: Pure "window dressing." Would be a help if it could be eliminated, but public would not stand for it. May open in any direction, left, right, up, or down. Louvers suggested for better circulation of cold air.

2. Shelves. Plain wire shelves will probably be retained. Flat wire increases cost and is not appreciated by public. Adjustability of each shelf two inches up and down being considered for new line.

3. Chiller Tray. Possibility of eliminating this tray entirely since it obstructs flow of air. Various schemes discussed for catching drip from defrosting.
4. Interior Light. 30-watt lamp used. Reflects in eyes when on display floor. Should be shielded.
5. Liner. Martindell spoke of adding radius to vertical rear corners to obtain optical illusion of larger capacity. Cosmic will try this on handmade model.
6. Automatic Defrosting. This with timing clock on door now being considered.

Mr. Wellington provided Martindell, Inc., with blueprints on 6 cubic foot box, and went over construction in detail from cutaway model. Tour of the plant. Sources of supply: Compressor made in main plant, evaporator in Plant 2 in Sellersville. Cabinet stampings made in main plant, liners trucked to Harrisburg for porcelain. (Note: Toggle press stroke limit, 12 inches. Two hydraulics, 200 tons, adjustable stroke, depending on job and setting.) Synthetic enamel for exteriors applied main plant. Aluminum escutcheon and evaporator door made by Selway, Uniontown. Hardware bought from two sources, one for Special, the other for Standard line. Cellulose insulating material from Cello, Inc., shipped in in bulk.

Advertising department provided catalogues, etc., and original ink drawing on "C" monogram. All patent data to go on back of cabinet next to wall. No special state regulations affecting design.

Martindell, Inc., to bring first rough studies to Cosmic plant week of November 3. All exterior forms, except latch, hinges, and identification, must be ready for detailing by January 10.

Copies to: Messrs. Earle, Camden, Williams, Jones, and Wellington.

All subsequent meetings with the client, either at his plant or in your own offices, should be covered by similar memoranda, until the project is finished. Important data obtained over the telephone should also be noted, typed, and mailed at once so that all files relating to the development will be up to date.

XV · Rough Visualization

WITH MATERIAL collected and thoroughly assimilated, work on the actual design is begun. If your hand trembles a bit because of the task before you, and you suddenly have that all-gone feeling in the pit of your stomach, console yourself with the knowledge that many experienced designers have solved problems brilliantly that were begun in much the same mood.

But hopeless as the task may seem to be, you must make a beginning; you must stick with it until *the* idea arrives, although it may take days, weeks, months. There exists almost no product of our machine civilization which, by manipulation, adjustment, and rearrangement cannot be made better looking, more coherent—how much better rests with your ability to visualize, your training, your background, your general knowledge, and your talent. Forget inspiration. It never comes if you wait for it. The old saw about genius being ninety-nine parts perspiration and one part inspiration goes for industrial design as well as for the other arts and sciences.

“Rough visualization,” as a stage in the evolution of a product design, is about the most difficult to describe in words. No two artists draw alike, nor is it necessary that they should. The dissimilarity between the approaches of a dozen industrial designers is as great if not greater than the differences in their handwriting. I have known excellent designers to make their early sketches in such miniature proportions that the drawings truly deserved the name “thumbnail.” Others will draw as large as the sheet of paper will allow. Some draw lightly and others with violent contrast of values. Some are tremendously prolific, setting down everything that occurs to them; others work slowly and more selectively, mentally eliminating many of the less promising treatments before they ever reach paper. Some are careless and dashing, smudging broad shadows with the fingers,

while others may use straightedge and compass for the outlines even in their earliest sketches.

The type of handling of the rough sketch is largely a matter of temperament; only practice and experience will teach you which technique and relative scale best suits your own particular quirks of mind. The essential thing is that the technique of sketching should become so easy and natural that it does not get between you and your mental pictures.

IMPORTANCE OF PERSPECTIVE

The important thing is to develop facility in drawing and visualizing *in perspective*, a matter emphasized in a previous chapter. This ability differentiates the experienced designer from the tyro; by that I mean the person who has perhaps studied mechanical drafting to the exclusion of freehand drawing and who comes to think in terms of "plan, elevation, and side view."

Any elaborate discussion of perspective or of shading and casting shadows would be out of place here, for there are excellent textbooks which cover both subjects simply and clearly (see Appendix B). The ability to draw in perspective does not require the genius of a Raphael; any intelligent person can acquire facility with practice. But you must study a textbook on the subject and practice the exercises with drawing instruments until

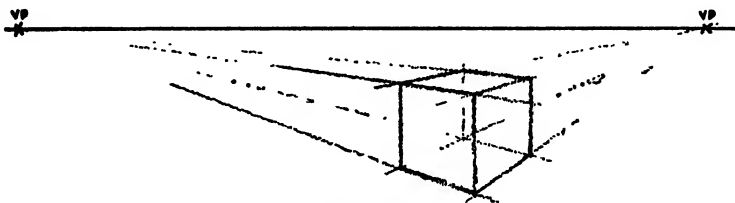


FIG. 111a.

you have thoroughly grasped the principles involved. After they are understood, however, you must discard T-square and triangle and practice them assiduously freehand. Perhaps we can give some practical hints which may help bridge the gap between the comforting security of the straightedge and the relative insecurity of the unaided hand and eye.

The transition between mechanical perspective and the freehand variety should be made gradually, casting up the

simplest geometrical forms at first and drawing them in many different positions. Locate the station point and vanishing points as accurately as you can freehand, using a T-square for the horizon line only. Let us demonstrate with a simple cube, show-

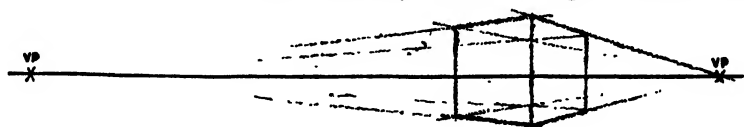


FIG. 111b.

ing it in three positions, each from a different station point, as in Fig. 111a, b, and c.

Soon you will be able to dispense entirely with the actual horizon line and vanishing points, and it will become second

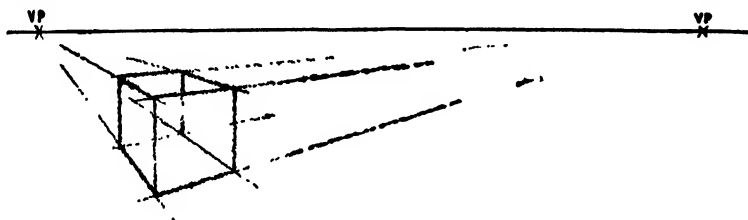


FIG. 111c.

nature to sketch all lines in the horizontal plane so that they tend to converge as they recede from the eye. It may be well at first to prolong these lines part way beyond the confines of the

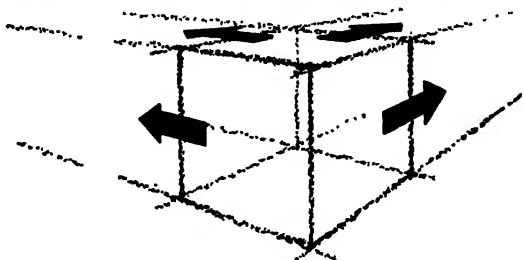


FIG. 112.

actual cube so that their convergence towards the imaginary vanishing points will be more apparent, as in Fig. 112.

If the station point is far above the object viewed, the text-books will tell you that parallel lines in the *vertical* plane also converge to a common point. But for the practical uses of rough

sketching in all fairly normal views, they may be considered parallel.

Reduced to simplest ABC's, then, the two prime rules of freehand perspective can be given as:

1. All parallel lines in the vertical plane are parallel.
2. All parallel lines in the horizontal plane converge to common points as they recede from the eye.

From the cube, proceed by logical steps to other simple forms of the parallelepiped, and then begin to combine them, as suggested by Fig. 113.

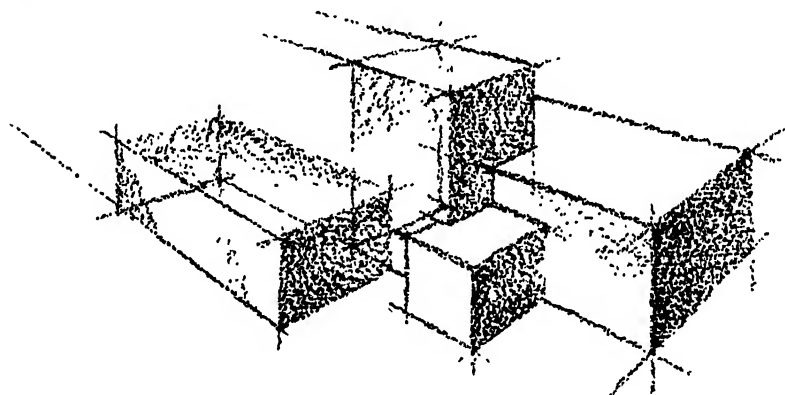


FIG. 113.

PYRAMIDS AND CYLINDERS

Pyramidal forms are merely logical and simple extensions of the principles applied to cubical forms, and are no more difficult to sketch if visualized as contained *within* a cubical form, as in Fig. 114.

The cylinder should next be studied and again the student should practice drawing it in various positions. This is more difficult because the circle seen in perspective is an ellipse, and we shall have two of them, each with a different minor axis, as a rule, although the major axes will be identical, as in Fig. 115.

Here it will be well to digress for a moment to practice drawing the ellipse. At first we should take it in its easiest form, that is, with the observer's station point directly in the center.

The circle can always be enclosed in a square, hence we should establish this square in its proper perspective, bisecting it in both directions. The vertical bisecting line then becomes the minor axis of the resultant ellipse, whereas the horizontal bisecting line is slightly above the major axis, as in Fig. 116.

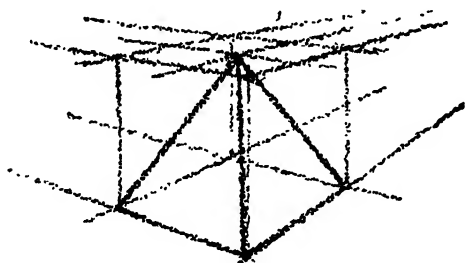


FIG. 114.

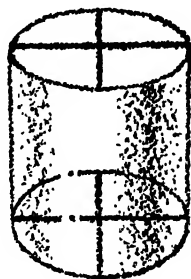


FIG. 115.

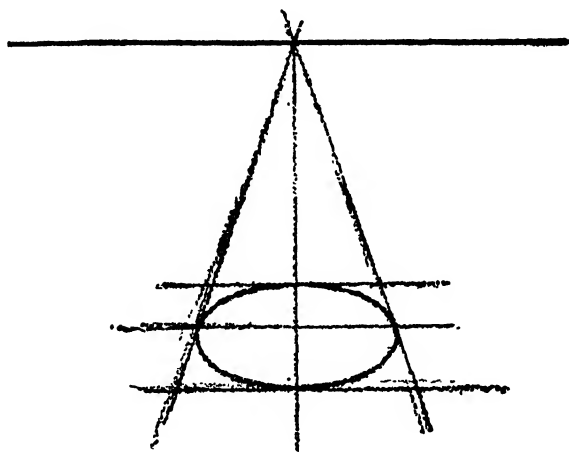


FIG. 116.

Although a circle seen in perspective is a true ellipse, its axes fall at odd angles which are not easy to determine. At first it would be well to plot the circle in perspective, point by point, as described in French's *Engineering Drawing*.^{*} There are instruments on the market called ellipsographs which will draw a true ellipse with any given set of axes, but a good one is expensive.

^{*} *Engineering Drawing*. By Thomas E. French. McGraw-Hill Book Company, Inc., New York.

Fortunately, however, most of the sketches we shall be required to make are of single objects, which can usually be placed directly in front of the observer so that the first type of ellipse will be more commonly used.

THE ELUSIVE ELLIPSE

There is a simple way of creating true ellipses which I should like to describe, with the hope that it may aid the student at the

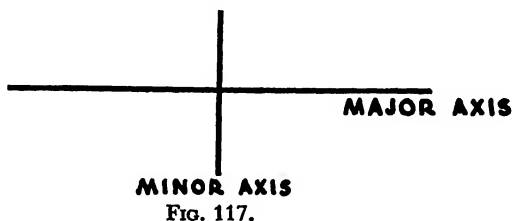


FIG. 117.

beginning until his eye is trained so that he draws them easily freehand.

Establish the major and minor axes of the required ellipse accurately. Then project the minor axis downward until the distance from the center point is at least as long as half of the major axis, as in Fig. 117.

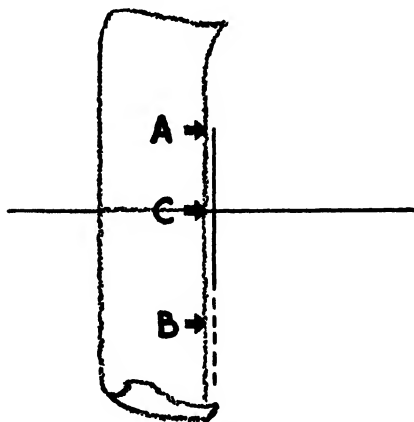


FIG. 118.

Now take a strip of paper having a straight edge and tick off first one-half of the major axis (AB), and then, within these marks, one-half of the minor axis (AC) so that the upper ends of both coincide at A , like Fig. 118.

Now twist this strip of paper counterclockwise so that C always touches the left half of the major axis and B slides upward always touching the lower half of the minor axis or its downward projection. Twist it slowly and at each stopping point (as many as you want) make a guide point on your drawing adjacent to A . You will then have a series of points that will

guide your line in forming the upper left-hand quarter of the ellipse, as in Fig. 119.

If you have made your drawing on tracing paper, you can fold it carefully, first along the major axis, then along the minor, and trace through the balance of the ellipse accurately enough for most purposes.

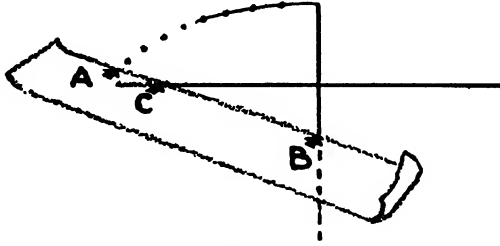


FIG. 119.

Although long in the telling, this method is really easy and rapid, and, like riding a bicycle, once you have learned it you never forget how.

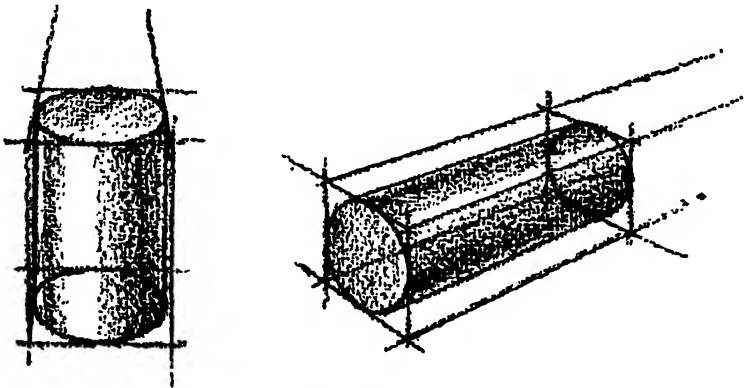


FIG. 120.

To get back to the cylinder. Like the cubical forms, these too should be practiced freehand until drawing them becomes easy. Always lay them out as if contained within a parallelepiped, with their sides tangent to the planes of the squarish form, as in Fig. 120.

CYLINDERS ARE DECEPTIVE

Cylindrical forms in perspective, when compared with a straight mechanical elevation, are surprisingly deceptive. In freehand practice, therefore, the student will gradually learn to take this into account and sketch them much longer or taller than they seem to be from a cursory examination of the mechanical drawing. In Fig. 121*a* and *b* will be seen the elevation view of an electric cooker, and a mechanical perspective of the same product.

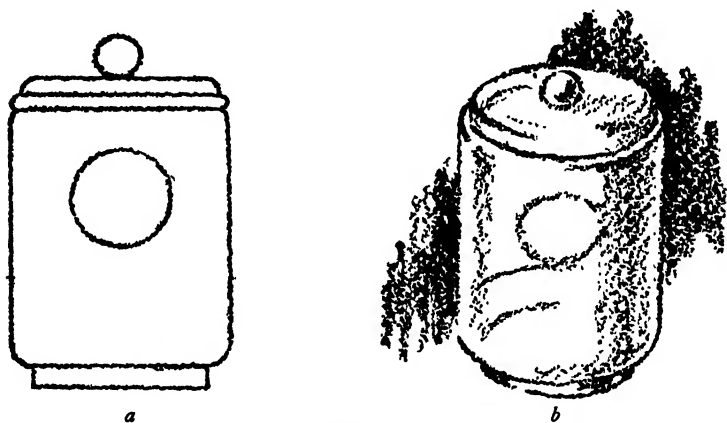


FIG. 121.

To sketch this freehand in an approximate perspective, we suggest herewith a procedure. Let us say that the total height of the product is 12 inches, the diameter 8 inches. Half size would be a reasonably good scale, 6 by 4 inches. Lay out the elevation to half scale in a mechanical drawing on the left-hand side of a sheet of paper and with the T-square project the lines across to the right side. Then draw a center line and locate the two vertical lines of the sides of the cooker equidistant from it. These should not be 4 inches apart, because, since the observer's station point is presumably about 3 feet away and, since all objects in perspective diminish in size as they recede from the eye, if we retained the 4-inch diameter, the resulting sketch would appear to be *more* than half size. We shall, therefore, reduce the diameter slightly, but how much?

An 8-inch circle seen from a station point six feet away will be reduced in diameter on the drawing by 7 per cent or about $\frac{5}{8}$ inch. The resulting circle in perspective will therefore have a diameter of $7\frac{3}{8}$ inches. Since we are working half size, we shall reduce the 4-inch circle by $\frac{5}{16}$ inch.

Then reduce the height by a proportional amount and establish the axes of the resulting ellipses, of which there will be four. Now swing your ellipses freehand between the vertical lines of the sides, making the bottom ones much more open. If you are not sure of yourself, check them by describing squares in perspective with the vanishing point where the center line intersects the horizon, as in Fig. 122. Once these two basic ellipses "look right," it is a simple matter to sketch the two or three others, round in the radii, and locate the lid handle.

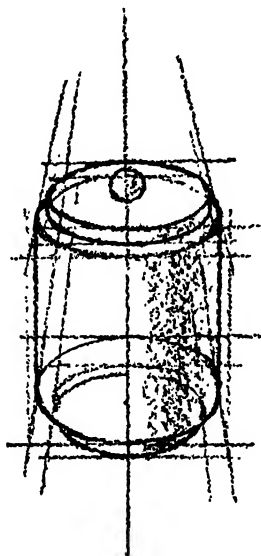


FIG. 122.

ABSTRACT EXERCISES

When you feel fairly sure of your ability to sketch cylindrical forms with ease, you should begin to combine them with cubical forms and wring every variation you can think of on abstract shapes. Half cylinders may frequently be met with in industrial design, where there is some reason to round the end of a housing. Always visualize the complete cylinder; then project the sides of the cubical form tangent to the cylinder, as in Fig. 123.

I know of no better practice for the student than such abstract exercises. You are not hampered by the many limitations and difficulties of actual products, and you are free to concentrate on the problems of freehand perspective delineation. Every so often you should check your sketches by laying out the design in plan, elevation, and side view with drawing instruments according to the rules in your textbook. This will show you where errors are creeping in and tend to correct your drawing.

There is no limit to the intricacy of forms you may devise during these practice hours. Various shapes may be interlocked

and combined, as in Figs. 124*a* and *b*. Surfaces may be cut into, stepped back, and pushed about on paper ad infinitum.

Figure 124*a* began as a simple cube with cubical buttresses at each of two sides. Figure 124*b* was a cylinder with an intersecting

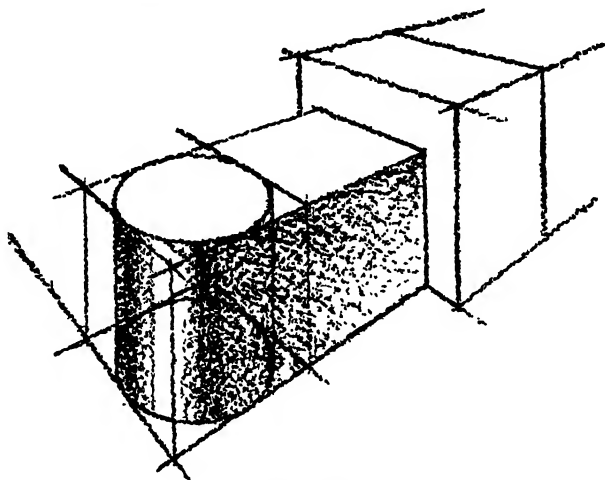


FIG. 123.

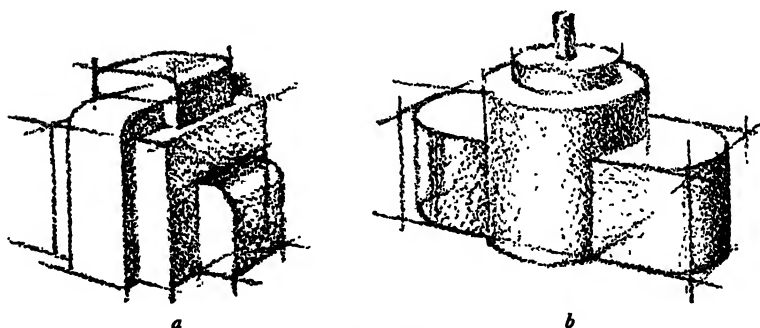


FIG. 124.

parallelepiped. They mean nothing and are not supposed to, any more than five-finger exercises can be considered meaningful music.

Such abstract sketching practice should not be indulged in at the expense of other kinds of training for the hand or eye. You should draw from the figure whenever possible, from still life,

portrait models, casts, anything you can find to help acquire facility. Although your aim is not to become a painter or graphic artist, any kind of artistic endeavor, no matter how far removed it may seem from the design of merchandise for sale, will contribute to forming your critical judgment and to the alertness of mind and eye.

XVI · Rough Visualization

(Continued)

FOR ROUGH visualizations, tracing or layout paper made up into pads is infinitely preferable to an opaque type of paper in loose sheets. The paper you choose should be semi-transparent, but from a stock which is neither too thin nor too dense. It should be transparent enough so that an outline drawing, even made with a fairly hard pencil, can be seen through it clearly, but not so thin that the drawing underneath becomes confused with the new drawing on top as you work. Furthermore, the paper should be tough enough to stand considerable erasure.

The “tooth” of the paper is a matter for individual preference, but you will find that a paper of medium fine grain is best for average work. Coarse-grained paper smudges more easily, especially if you use a soft pencil.

This tracing paper may be made up into pads glued at one edge and mounted about 40 or 50 sheets to the pad. Such a pad is agreeable to work on, and the cushion of sheets underneath makes a resilient surface for the pencil. This cushion is necessary if you are shading or putting in backgrounds with a graphite stick, described later.

The paper stock can be obtained from wholesalers; they will pad it, with a stiff cardboard backer on each pad, according to your specifications. Tell your supplier to avoid using cloth on the glued edge because this forms a ridge as the pad is used up and gets in the way when you are using the T-square or triangles.

The size of these pads would also be a matter for individual preference were it not for the fact that all sketches should be preserved and filed. The reasons for this will be set forth in Chap.

XXV. If sketches are to be preserved, it is obvious that the simplest and most compact way of keeping them should be adopted. You will find that two sizes, 11 by 17 inches and 17 by 22 inches, will make the most satisfactory sketch pads because they are multiples of the standard $8\frac{1}{2}$ by 11 letterhead. The smaller size, folded once, and the larger, with two folds, can be stored under account or job headings in standard Manila index folders and filed vertically in any standard letter file. Special sizes of letter cabinet files can of course be purchased, but they are expensive. A filing system is described in detail in Chap. XXII. Furthermore, these sizes are convenient for mailing together with a letter in one of the regular No. 9 or No. 10 business envelopes.

The reason for using a semitransparent paper is merely to save time. If, for every successive redrawing of a design you had to sketch it freehand all over again, the amount of labor would be infinitely increased. Of course this is not news to any professional designer, advertising layout man, or commercial artist, because it is standard practice everywhere, but the novice often does not know about it. Aspirants who besiege the offices of any designer bring drawings that have obviously been worked out without the benefit of this laborsaving device.

With a pad of this paper on your drawing board you can, once you have your basic proportions, produce dozens of variations on a given theme in a short time.

As I have said before, the term "rough visualization" is extremely elastic. The quick scrawl put down under pressure in great haste will differ widely from the type of sketch shown to the client for discussion. Your drawing may be done in pencil, chalk, or crayon; it may be almost complete enough to be called a "rendering," and still be classified as a rough visualization.

SKETCHING A PLASTIC RADIO

Most products have a predecessor, a form or shape which will define the limits within which your redesign must fit. Let us suppose you are commissioned to design a molded plastic cabinet for a small table radio. There is an already existing chassis, which fixes the general proportions within perhaps a few fractions of an inch in either direction. You may be allowed some latitude, but

not much. Also, the position of the speaker is established. The client has intimated, however, that a "radical" design might be received with some interest.

All speakers are flattish cones, hence round in front view, but the size and shape of the actual grille opening in the molded cabinet will allow considerable latitude for your ingenuity. Similarly, the dial opening may take various shapes.

Now, since your assignment is to work with an already existing chassis, it would be foolish to spend much time daydreaming on

paper without regard for basic dimensions; before you know it you will, in successive sketches, have drifted so far away from the proper proportions that the resulting ideas or themes are valueless.

The client will provide you with a blueprint of the chassis, or some kind of drawing giving the basic dimensions, and the centers to which you may work for the tuning knobs. Figure 125 shows simplified elevation and plan views of this drawing, although his print must of course show side view as well. Now convert this into perspective (see Chap. XIV) showing merely a box-like shape with crossed lines

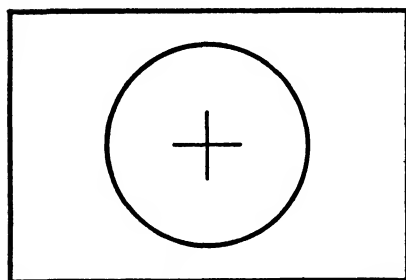
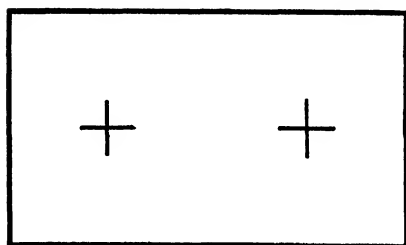


FIG. 125.

indicating the exact location of the knob shafts, and an ellipse to show the approximate location of the speaker, as in Fig. 126.

The size of the basic perspective outline is a matter for individual preference. If you have cast up your perspective from a quarter-size plan and elevation, the resulting sketches of an object which is not large anyway will be rather small for comfortable freehand work later on, although, I repeat, this depends largely on the temperament of the artist. Half size would be a good manageable proportion and would enable you to make two

"roughs" on a single sheet of 11 by 17 paper. Make your perspective outline black enough so that it will show through one sheet of the pad, and insert under the top sheet, Fig. 127. This will give boundaries within which you must work. You are now ready to begin the actual job of creating something new and beautiful in molded radio cabinets, and from that point on it is up to you.

As everyone knows, it is easier to trace another drawing than to draw freehand on a blank sheet of paper. Therefore, you will probably have little use for T-square or triangle until later stages when the design is crystallized to a point where it is satisfactory to yourself and you wish to "tighten it up" a bit.

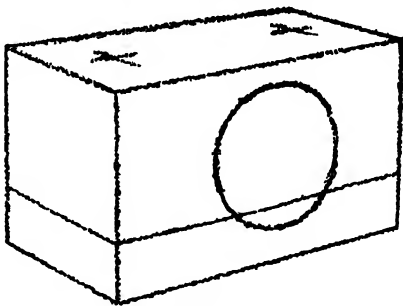


FIG. 126.

THE THEME EMERGES

When the theme begins to emerge, you will probably use each successive sketch to put under your fresh sheet of paper for tracing, rather than the original perspective outline. This will enable you to make slight changes and alterations as they occur to you, without redrawing the entire form each time. However, be careful to check back from time to time with the original outline, otherwise the inaccuracies of your freehand lines may gradually, as the work progresses, multiply themselves to the point where the basic dimensions have been lost.

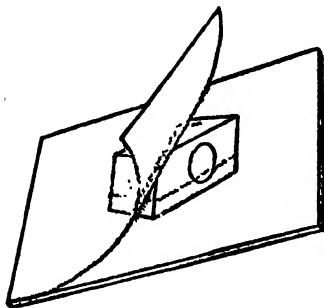


FIG. 127.

It might be objected that this procedure is cramping to the free expression of ideas. I believe, on the contrary, that it liberates rather than hampers, for it provides security of dimension and proportion, leaving the mind free to play with variations on a theme. Of course you may make many excursions away from this

hard and fast rule, and cast up enlarged details of parts of dial, escutcheons, selector buttons, etc. Your tracing sheets will probably be covered with sketches of sections through certain areas, and miscellaneous details that may need working out in order to discover whether or not a given scheme is practical. The margins of your drawing sheets will also be littered with penciled notes, color suggestions, ideas for surface treatments, etc.

Plate 2 is presented as a demonstration, much more illuminating than words, of how one typical design problem might be brought through the rough-sketch stage. Space limitations, of course, prevent showing more than a few of the many studies that were made before the last one was completed. You will note how the sketches acquire finish and sureness as they advance, after the tentative quality of the early ones. Some of the later studies were done almost entirely with a graphite stick, outlines and details being drawn with various grades of pencil.

Just a word about these tools of the trade. Everyone knows that it is difficult to draw freehand with a hard pencil. Therefore most rough sketching is done with varying grades of soft leads from HB to 6B, but the softer the lead the more rapidly it wears down and needs resharpening. The resulting mess and loss of time may be annoying. Therefore it is best to use cartridge pencils, which can be obtained at any drafting material store, and to buy refills by the box in various grades.

A TIMESAVER

Graphite sticks can likewise be purchased from any material store. They are most useful as a timesaver, especially in making large sketches with broad, plain surfaces, such as the shadow side of a refrigerator or stove. In a few seconds a soft gray can be laid in which would take ten times as long if the shading were done with a pencil point, as in Fig. 128.

These sticks are square or rectangular, about three inches long, and are sold in grades from 3B to 6B. They will produce anything from the faintest gray to a rich velvety black. Guide them with a straightedge and they produce a broad shadow tone without the aid of a pencil outline (Fig. 129).

The manipulation of these sticks requires some practice and skill, but in addition to making an attractive and professional

looking sketch they are great timesavers. An example of their use in a finished sketch will be seen on Plate 8.

There is another type of pencil valuable for rough sketching which may suit your particular temperament better than the

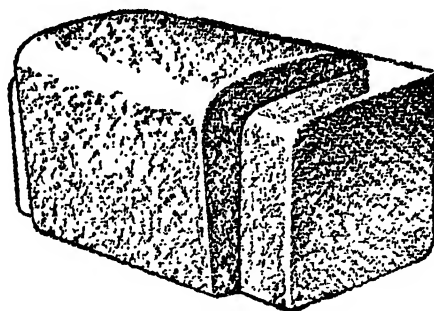


FIG. 128.

standard graphite type. It is the so-called carbon pencil, which can be had in several grades, HB, B, BB, and BBB. Unlike soft graphite, which has a certain amount of shine, they produce a matt tone. You cannot use them at all on shiny or coated paper,

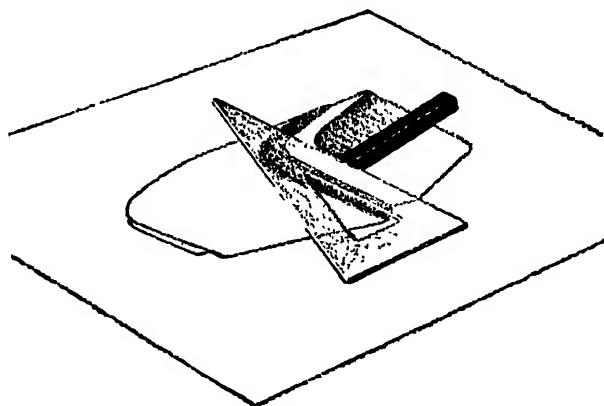


FIG. 129.

but they work well on any paper with a tooth. It is easier to draw a steady line with these carbon pencils because they are porous and cling to the paper surface. You do not have quite so much flexibility as with graphite, and erasures are more difficult. Some-

times they contain gritty particles which have to be removed; in the harder grades they are rather brownish in color; but for certain types of sketch they are useful, especially if handled in the following manner.

RUBBED RENDERINGS

Take one of the softer grades, BB or BBB, and sacrifice an inch or so of the lead to preparing a fine powder by rubbing it down on your sandpaper block. Catch these filings on a piece of paper or a china dish. Then dust this powder, a small amount at a time, over the top sheet of your layout pad and rub it gently and evenly into the paper with a wad of cotton until you have produced an even gray tone. Be sure that the paper has a number of other tracing sheets underneath to form a cushion. Otherwise your tone will tend to be streaked.

This gray tone will provide you with the "middle gray" value for your sketch. You can then make your darks with the carbon pencil point and pick out your lights with kneaded or dough-type eraser, worked up in the fingers until it is soft. The eraser will remove the gray tone, leaving white paper; thus broad lights may be wiped away in a few seconds. By wrapping a small piece of soft kneaded eraser around the end of a pencil or the lead end of a pencil compass and working it to a point with the fingers, sharp high lights may be obtained. Gray lines, or shadows darker than the basic gray tone, can be put in with the pencil point and rubbed to a soft, even tone with a paper stump, of the kind that can be purchased in packets at any art store.

This whole technique is similar to the way the art student makes a charcoal drawing; but charcoal is a messy material hard to manipulate except on an easel. Carbon pencil drawings are relatively hard to smudge and really "stay put." Furthermore, they do not need to be preserved with fixative. For an example of a sketch prepared in this manner, see Plate 5.

This chapter will have missed its aim if it hampers the student with too specific directions. It is merely meant to point a way, and to bring to his attention a few practical suggestions that may make his path smoother. There are many other media that might be used in producing rough sketches: pencil plus wash or water color, colored crayons, lithographic crayons, even pastels. The

sky is the limit as long as you are satisfied that it suits your own style of working and does not "get in your way."

The black and white methods suggested above have been found to be practical and simple. Soft pastel sketches smudge easily, and cannot be folded and put away for reference in files. Lithographic crayons and other grease pencils are difficult if not impossible to erase. Any one of these media, however, is worth experimenting with even if only for a change of pace after you have grown tired of working with another kind and want to loosen up a bit.

COLORED PENCILS

Sets of colored pencils come in assortments of 12, 24, 36, and 60 in a folding box, which makes a convenient holder while you are working. Such a set is indispensable in any design studio. Colored pencils can be combined with pencil sketches in making rough studies for some product where color separations are important from the start; they may help your client visualize his product more as it will appear in the flesh.

For drawing small objects such as cosmetic items, knobs, dials, etc., it is best to use colored pencils, water color, airbrush, or wash. Colored pencils may also be used to point up small details on chalk drawings.

USING HARD PASTELS

So much, then, for the kind of rough visualizations you may make for your own information. There is another type, however, which you will want to make for presentation to your client and which requires a good deal of skill: the chalk or hard-pastel drawing in full color. Such a sketch may be finished enough to be classified as a rendering, but since these drawings usually take less time to prepare than airbrush drawings and make exceedingly effective presentation drawings in the early stages, I shall describe them here.

Hard pastels come in boxes of 12, 24, 36, or 48. They are different from the soft pastels the portrait artist uses in that they are square instead of round. They have a shiny, hard outer skin or shell which has to be sanded off before they will make a mark.

They are generally used on a tinted charcoal paper, on a good tinted cover stock, or on a fine sandpaper especially made for pastel painting. Such papers can be obtained in various colors, the particular hue and shade being governed by taste or the particular subject to be sketched. A light gray, for instance, will represent the "half tone" in a product to be made in porcelain enamel; whereas the pure white pastels may be used for high lights, lighted or reflecting surfaces, and various tints of gray pastels for other modeling which may be necessary. Backgrounds can be put in in color and vignettied. For particularly intense spots of white, tempera paint may be added with a brush or a ruling pen.

These pastels are laid on with the flat side of the stick and then rubbed in with the finger for blending and softening. To describe in words exactly how to make such a drawing would be impossible. You are really painting a picture and that takes experience and a certain amount of color knowledge and artistic training. Plates 6, 7, 14, and 15 show several of these sketches reproduced in black and white. They have the character of sketches rather than finished water-color drawings or airbrush renderings, yet they can be made more rapidly and easily than either. They are effective in telling the story to the client in terms he can easily visualize. In other words, they are valuable halfway steps between the rough sketch you do for your own information, and the finished rendering or model to be presented later.

Certain intermediate steps are necessary before a pastel sketch can be made. Getting your finished outline traced down on the pastel paper or other rendering stock is a tedious but essential job. No effective way seems yet to have been devised but the laborious one of rubbing the back of the tracing sheet with a graphite pencil, thus forming a kind of handmade carbon paper. The tracing is then tacked down on the drawing board over the pastel paper and each line gone over with a hard, sharp pencil. (Regular carbon paper will not do; it is too greasy and will not erase easily.) The resulting outline then forms the basis for your pastel drawing.

If the color of the paper you have chosen is black or some darkish shade, the same result can be obtained by rubbing the back of the pencil tracing with white Conté crayon or chalk, thus producing a light outline on a dark background.

Hard pastels do not smudge so easily as the soft variety, but they are not indestructible and should be carefully matted and covered with cellophane as described in Chap. XVIII.

PHOTOSTATS

To save time in making rough sketches, the photostat is a most useful tool. Photostats are made in both negative and positive form. The negative is made first, developed and dried; the positive is then made from the negative. Therefore, any number of positive copies can be made, once you have the negative, although the first positive costs double. Certain types of drawings and photographs are impossible to trace from a negative print even with extra-transparent tracing paper. With a little experience you will know whether to order a negative only, or a negative and positive too.

It is possible to enlarge or reduce an image photostatically with great accuracy. They are extremely helpful, for instance, when you want to reduce or enlarge a name plate slightly. A simple catalogue half tone, photographed in perspective, can be "blown up" photostatically, traced in outline, and used as a basis for making your early visualizations.

The various media described above have been found the most practical for preparing rough sketches. Water color has not been discussed in detail for, although beautiful, it requires exceptional skill and is difficult to alter; it is a study in itself. There are many handbooks exclusively devoted to its technique.

XVII · Clay Studies

THE INVENTOR of the nondrying modeling clays, variously called plastine, plastilene, or plasticene by their manufacturers and disrespectfully dubbed "putty" or "mud" by some people who use them, deserves a vote of thanks from every industrial artist. They are indispensable because they require little care, retain their shape indefinitely, and can be worked over and over again.

To describe the material itself is hardly necessary since everyone who has ever been to kindergarten has handled it. Many, however, do not know that it can be obtained in several colors and varying degrees of consistency. For the use of pattern makers a brick-colored wax is made in consistencies so stiff that it has to be worked with instruments. A grayish-green clay which works readily in the fingers, however, is usually preferred by sculptors and industrial designers.

Clay studies are simply visualizations in three dimensions instead of two. The industrial designer is really more sculptor than artist of pencil or brush. Many design problems, especially if freehand forms are involved, are carried through from start to finish without touching pencil to paper until mechanical drawings are made. You must have facility with the pencil, of course; but sketching and modeling often proceed side by side and, as you gain experience, you will find yourself depending more and more on clay and less and less on paper.

Some clay studies may be comparatively rough. If you are studying parts of a design which, because of a complicated juncture of different radii or because the amount of relief necessary to obtain a certain effect is in doubt, clay used right at the drawing board will clear things up in a fraction of the time required to make a shaded drawing. In rough work of this sort an ordinary kitchen knife and perhaps one or two small modeling

tools will be all the equipment needed, except for the most versatile of all tools, your fingers.

On the other hand, clay models may be brought to a high degree of finish. This is necessary, of course, if you expect to make a plaster cast from your model. But in designing geometrical forms, that is, forms made up of straight lines and compass curves in various combinations, you may also wish to make rather accurate clay studies. The procedure involves a special technique.

CLEARANCE MODELS

It is presumed that you have gone far enough to lay out your design roughly in elevation, plan, and side view. The next step is to build a clearance model of wood, use it as a core or "armature," and model the clay over it. By "clearance model" we mean one that will allow for all fixed dimensions as well as the extreme outward position, movement, or swing of moving parts.

For example, let us take the wringer gear housing of a washing machine. In Fig. 130 we have a simplified drawing of the mechanism. Taken in their proper order the parts are as follows: *A* represents the drive shaft connection with its bevel gear. *BB* are the bevel gears which change the direction of movement from vertical to horizontal. *C* is the eccentric which moves these gears into three positions: forward, neutral, and reverse. *D*

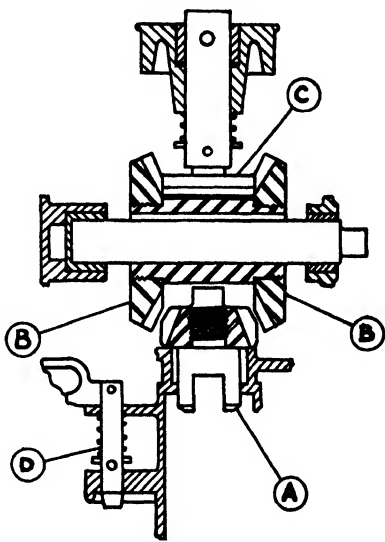


FIG. 130.

is the spring latch which, when released by finger pressure on the lever outside the housing, permits the entire wringer to be swung in an arc around the wringer post. It can be fixed in twelve different positions corresponding to twelve notches in an index ring.

Now translate this drawing into a clearance-model drawing. The first step is to take the client's drawing literally and trace lines around the outermost points of all the stationary parts. Then, since the pair of bevel gears which actually drive the wringer roll have about an inch of maximum travel, you must provide clearance for both extremes of this movement. This is duly accounted for in your outline. When the first drawing is completed it looks like Fig. 131, although only the elevation is shown.

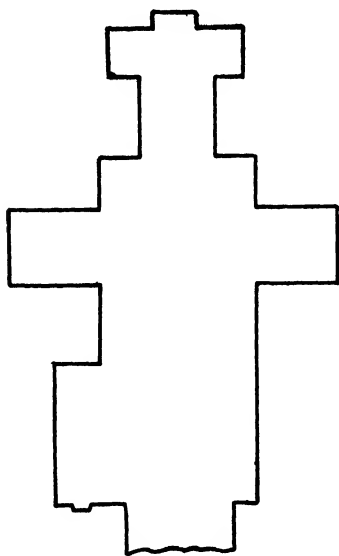


FIG. 131.

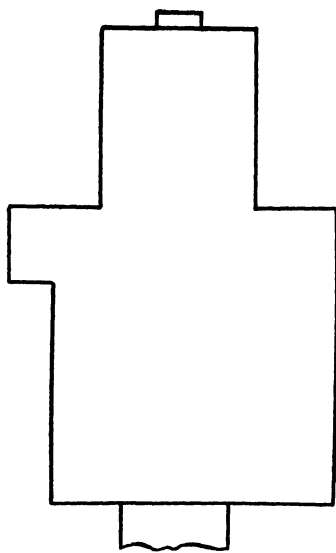


FIG. 132.

If you made your clearance model exactly to conform to this drawing, you would put the model maker to a good deal of unnecessary trouble. It is obvious that the finished housing, a die-casting, would look very odd if it followed all the ins and outs of the gears and would be difficult to cast, too. Further, it would be difficult to finish with enamel and hard to keep clean in the home. Therefore you fill in the gaps, making a smoother armature and one that is much easier to build, as in Fig. 132. If you wish you can make still further simplifications dictated by the ideas embodied in your rough sketches. Experience will teach you how intricate or how simple to make these wooden armatures.

Some like to make armatures with the "clearance" plus material thickness already added, that is, with an added thickness of wood of $\frac{1}{8}$ or $\frac{1}{4}$ inch—like the peel of an orange. Others prefer to construct them so that their exterior represents the extreme limits of the moving parts, then add clay for the required clearance or air space. The first method saves a lot of time if you know exactly where your final surfaces are going to be, because when clay is added for the changed parts, the wood itself can be sprayed with color to match the clay. In the latter case you can slap on the clay and model freely, at any time poking some blunt instrument like a wire nail, or better still a small steel scale, into the clay until it touches the wood, then subtract the clearance specified.

With the armature completed, the clay is pressed on roughly and as rapidly as possible, building it up to the approximate bulk required. Figure 133 shows a phantom view of one possible design

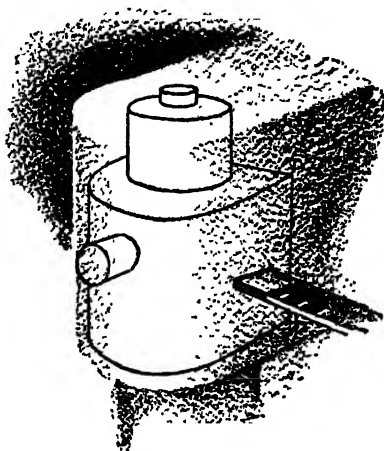


FIG. 133.

using this wringer gear housing as an example, and indicates how you can "feel" for the armature under the coating of clay.

The beginner has little difficulty in roughing out a clay model to the approximate form he desires. But as it draws nearer to completion and he wants to produce accurate surfaces and precise radii, he finds the clay increasingly difficult to manipulate in a clean-cut manner. Fortunately there are a number of short-cuts, simple if you know them, that will give your model a professional touch.

MODELING WITH ZINC TEMPLATES

Let us take some simple form such as a safety-switch housing for commercial or industrial installations. These metal boxes are usually mounted vertically against a wall or on a pillar, although for purposes of illustration this one is shown lying flat on a

horizontal surface. The cover is hinged at the left-hand side, the lever at the right serving to throw the switch tumblers into or out of contact with the prongs. Figure 134 shows the finished product we are planning to render in clay.

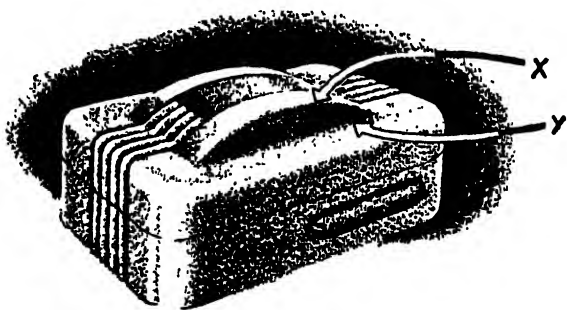


FIG. 134.

The rough sketches have settled many points in the design, such as necessary over-all dimensions, clearances for the throw of the switch, location of the hand lever, approximate decorative treatment of the hinged cover, and handling of the name plate and instruction data. But we have never seen it in three dimen-

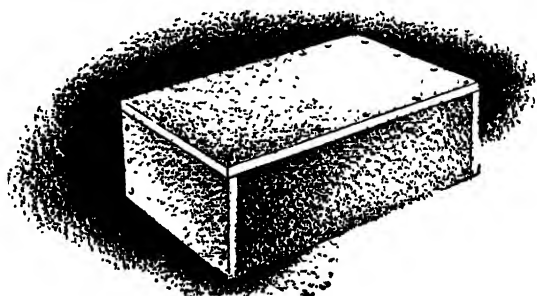


FIG. 135.

sions. There are several points we wish to study further, such as the exact dimensions of radii along the edges and the number and width of ribs, before we make our presentation to the client.

Inasmuch as the product is only 7 by 12 by 5 inches, the problem of scale is easily disposed of—there is no point in making

it anything but full size. First we knock together a rough wooden armature, little more than a box, in order not to waste time building up the entire form bit by bit, as in Fig. 135. This is not a clearance model, merely a timesaver. The nature of the product is such that the general dimensions of this particular size of switch box have been pretty well established in advance.

After clay has been generously slapped on, we begin to scrape down the top (really the front) of the cover with a piece of sheet steel with a true edge until the clay is smooth, and, when checked with the spirit level, is parallel with the workbench. The sides are scraped in like manner and maintained at a 90° angle from the bench by checking with triangle or square. When the main

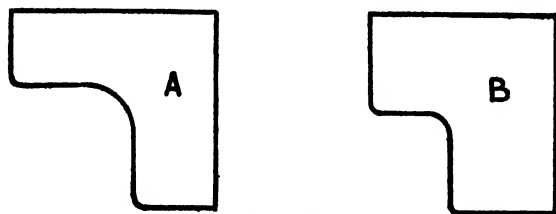


FIG. 136.

form is accurately established, we cut two templates from sheet zinc to conform to the corners *A* and the edges *B*, as in Fig. 136.

To make these templates, mark the desired radii out on the surface of the zinc with a pencil compass or scribe the necessary lines with the sharp point of the dividers. The rough cutting can be done with tin snips (there are snips made especially for cutting curves) and the balance filed away until the edge of the zinc is smooth and follows the contours exactly. If the cutting distorts the zinc out of flat, it can quickly be smoothed out by clamping it between the jaws of a bench vise.

Leave enough straight edge at both ends so that the templates will be supported by the main mass of clay on the sides of the box, and file away sharp corners which have a tendency to dig in and spoil the smooth clay surfaces. Now use template *A* as scraper for the corners, pulling upward until all the excess clay is removed and the required radii are established as in Fig. 137. We are then ready for the second template *B* to finish the edges around the front cover. This is made in the same manner and the

edges scraped down until we have completed the main form of the box, minus the arched section in the cover.

The reason for omitting this bulge in the first stages of the work is because it is much easier to establish smooth plane sur-

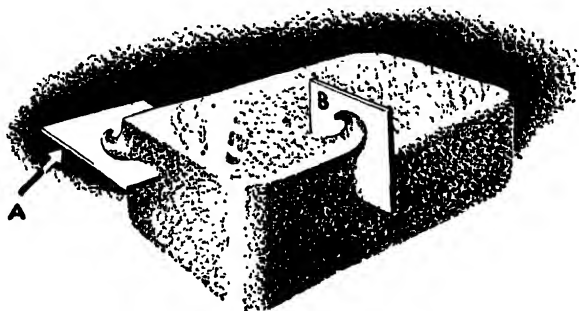


FIG. 137.

faces and then add to them than it is to model the entire form at the beginning.

Now mark out the dimensions of the arch on the flat plane of the cover and begin adding clay until it exceeds the amount actually needed in the finished piece. You will realize by now



FIG. 138.

that the basic principle is to make the rough model oversize and then scrape it down to the size required, rather than attempt to build it up to exact dimensions bit by bit.

Now heap the clay up on the surface and cut another scraping template to conform to the arc of the surface bulge. Since this is rather large and sheet zinc bends out of shape easily, reinforce it with a piece of wood cut to a slightly larger radius, fastening the zinc to the wood with steel tacks (Fig. 138). Observe that this

template also is made with ample flat at both ends so that its edges will not gouge the smooth surface of the top, and that the zinc protrudes about $\frac{1}{8}$ inch beyond the wood wherever it is to scrape, but is flush with the wood where it rides on the surface of



FIG. 139.

the top, for here you need as much bearing as possible. For even more accurate results, the wooden reinforcement may be made to extend beyond the ends and can be guided on wooden rails nailed to the workbench.

FILLETS AND RADII

Two more scrapers remain to be filed out as shown in Fig. 139, one for the small radius that follows the arc of the raised

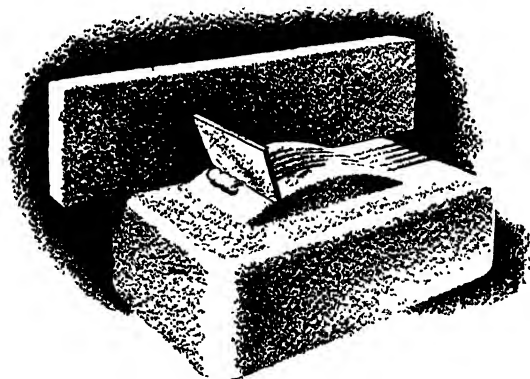


FIG. 140.

part on parallel edges, *X*, and a small one for the fillet which will occur where the bulging part meets the plane surface, *Y*. Neither need be reinforced with wood since they can be held firmly in the fingers without bending. A little handwork with modeling tools will be needed at the four points where radius and fillet meet to join the flat surface of the cover, *X* and *Y* in Fig. 134.

The model is now complete except for the decorative ribs. Since this cover will be made on stamping presses, the ribs are to

be pressed into the metal so that the peaks are level with the plane surface and the valleys $\frac{1}{16}$ inch below. Mark these out on a piece of zinc and cut and file the ribs to the *reverse* of the contours wanted in the clay. This template should be guided against a smooth piece of wood cut out on the jigsaw with an arc slightly larger than the bulge, and held firmly with the left hand while the scraping is done with the right (Fig. 140).

PAINTING THE CLAY

It is perfectly possible to paint this model in order to study the final effect. The clay is first given several coats of casein paint, each sanded smooth, then the finish coat or coats sprayed on with a gun. If these preliminary precautions are not taken, the oils in the clay will bleed through the paint or lacquer in a few hours, leaving a greasy film and discoloring the finish coat. Examples of painted clay models, in varying stages of completion, are to be found in Plates 9, 14, and 15.

If great care is exercised and enough coats of casein are applied, each sanded in turn, a clay model can be brought to almost as fine a finish as one made of plaster. The effort is seldom worth while, however, unless time does not permit of making a finished plaster model. These clay studies are made expressly so that we can change the size of radii or fillets, modify the character of the ribbing, or otherwise perfect the proportions. With soft clay it is a simple matter to add more clay, cut new templates, and scrape out the new shapes.

Although the description sounds tedious, this method of modeling mechanical forms in clay is actually far more rapid than building them up by hand and results are more satisfactory.

The example chosen for this demonstration is a simple one, but it contains, in little, nearly all the points of technique involved in making clay models of products without freehand contours. Experience will teach the student many time-saving variations. Even freehand curves, provided they curve only in one plane, can be rendered with these scraping templates. The example we have just used might have been designed differently, with a freehand curve sweeping down the face instead of a segment of a true circle. In this case the scraping template would be laid out on the zinc, cut and filed to the desired contour, rein-

forced with wood, and the contour scraped out by pulling the template across the face of the model as previously described (Fig. 141).

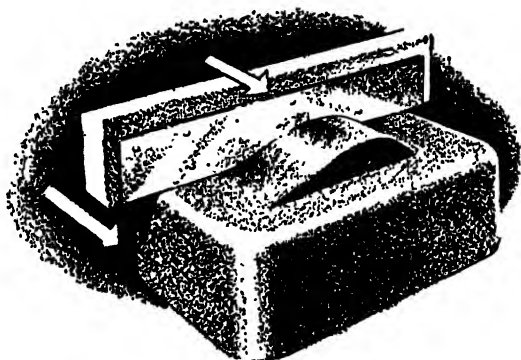


FIG. 141.

CIRCULAR FORMS

Circular forms, such as a series of beads, flutes, or grooves, are easily scraped in the clay by firmly fixing a large nail in the center of the circle, bending the end of the zinc into a loop and soldering it fast, then swinging the template around the nail as a center post, as in Fig. 142.

The really well-equipped model shop will have a special piece of equipment, inexpensive to construct, for scraping circular forms in clay or running them in plaster. It consists of a flat wooden surface from the center of which rises vertically a steel or brass rod. A medium-sized bread board will serve for the wooden base. To the center of this a socket is

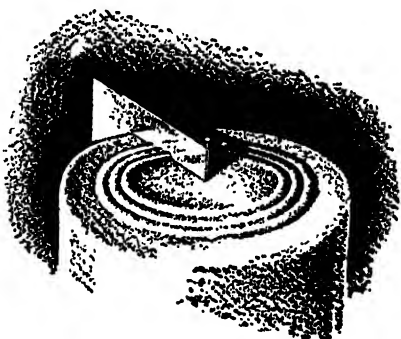


FIG. 142.

screwed. The hole in the socket may be threaded to receive a similarly threaded rod about $\frac{1}{4}$ inch in diameter. When working with wet plaster (see Chap. XIX), a sheet of polished plate glass, cut to the size of the board or smaller, is added. A hole is cut out in the center of the glass to fit closely around the socket (see Fig. 143).

With this device various circular forms may be turned out. In fact it will simulate any form that can be made on a lathe (see Chap. XII). Clay can be heaped around the center post, a template cut and looped around it as described above, and the template swung circularly until the clay is scraped smoothly to the desired contours. The rod can then be removed and the hole puttied up.

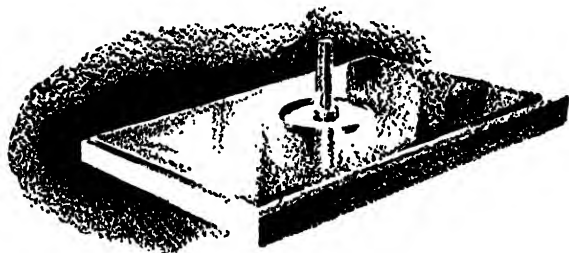


FIG. 143.

Small round parts such as knobs, which would be difficult to model in clay, may be turned out of wood on a lathe and painted a grayish-green to match the clay.

FREEHAND FORMS

Modeling freehand forms requires great skill and long experience. Since the clay is being manipulated by a sculptor, results are dependent largely on the talent and originality of the designer and his feeling for proportion and form—qualities gained only through long contact with varying problems. Even here, however, there are short cuts. Let us suppose that we are modeling the front end of a juvenile automobile, or perhaps a quarter-scale study of a full-sized car. The finished model, minus fenders, is shown in Fig. 144.

We have built the wood core or armature, this time of various pieces of lumber nailed together roughly to represent the chassis. A length of steel rod is affixed to the underside to represent the front axle. Down the center line we fasten with cleats two vertical pieces of plywood, the upper edges of which have been cut out on the jig saw approximately to the contour of the center line, but about one inch shy of the eventual surface of the clay which will cover them. In the slot formed by these two boards we place,

removably, a stiff sheet of steel or brass, about 18 or 20 gauge. This is allowed to extend an inch or more above the surface of clay. The armature is shown in Fig. 145.

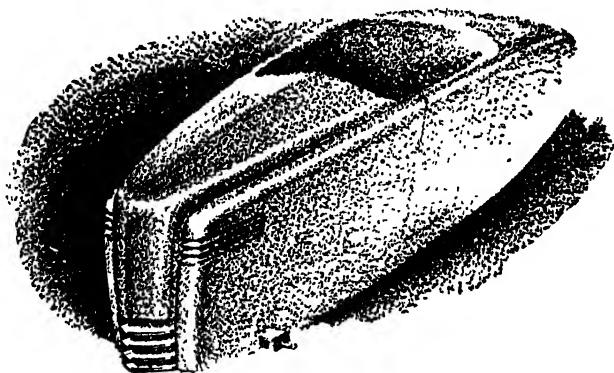


FIG. 144.

Compo board or some light material is now nailed in to save clay. When the clay is puttied in and built up in generous masses, we begin the modeling process. We use scrapers and modeling tools of varying kinds, one of the most useful for purposes of freehand modeling being a metal loop fastened to the end of a

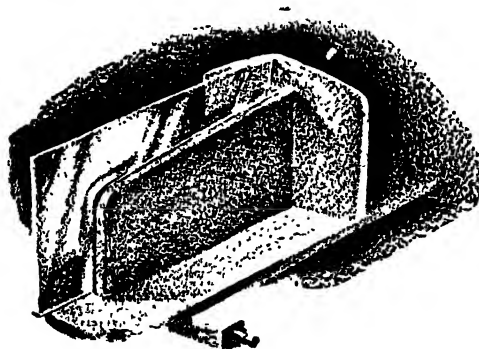


FIG. 145.

wood handle, shown in Fig. 146. The two sides are modeled at first approximately alike to give a rough impression of the bulk we wish to obtain. As the work progresses, however, more attention will be given to one side and the other will be shown reflected in a mirror which has been temporarily substituted for the

metal sheet in the slot. (A plated and polished steel mirror will be found good for this purpose.) When the desired contours of the hood and radiator grille have been obtained, the mirror can be removed and the sheet of steel replaced. This now forms a guide for locating templates which will be cut from stiff cardboard to



FIG. 146.

fit the hood or fenders at intervals of several inches on the finished side, as in Fig. 147. These cardboard templates are then flopped over to corresponding locations on the unfinished side and pressed home into the clay, making marks which guide the modeler in scraping off the excess. Thus in a short time the left-hand side can

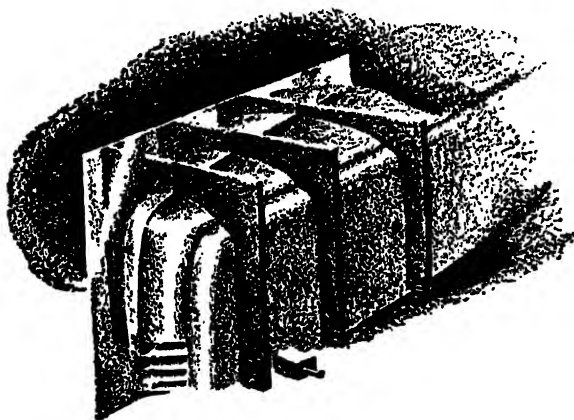


FIG. 147.

be made to match the right exactly, the sheet steel removed from its slot, and the crack puttied over. We now have an accurate clay model of the finished hood and grille, which, if desired, can be treated with casein paint and sprayed with lacquer or enamel to simulate the final product. Fenders, although omitted from the drawings above, can be modeled and checked in like manner.

Modeling clay must not be thought of as material useful only in making small models. It can be used freely in making alterations on full-scale wooden dummies or metal models. We have built adjustable armatures 6 feet high and used hundreds of pounds of clay to study subtle refinements of large machines; in automotive work, full-size clay mock-ups are always made for study purposes.

EQUIPMENT

At the close of the next chapter will be given a complete list of materials and tools for the model shop. In mechanical equipment the sky is the limit, but there is a minimum below which one cannot go without seriously lowering efficiency and slowing down speed of operation. We shall, therefore, give only those items that seem essential.

Bench-type lathe: There are many of these on the market. You should study various makes to determine which best suits your requirements. It should have a tilting table with setting for various angular positions and the necessary clearance to turn pieces up to six inches over the bed. Three or four speeds are desirable. A sanding disk attachment is important.

Motor-operated jig saw: It is possible to do without this, but it will eliminate a great deal of handwork in preparing armatures, building special cases for carrying and shipping models, etc.

Compressor and pressure gauge: This should give up to 40 pounds pressure. In place of the compressor a cylinder of carbon dioxide can be used. This can be obtained from any soft-drink bottling works or commercial chemical house and when empty may be replaced with a full cylinder.

Spray gun: For most small-scale model work, it is not necessary to invest in a regular commercial- or industrial-type gun. Some good inexpensive outfits are on the market with adequate glass or metal paint containers.

Soldering outfit.

Small power drill: Either electric or pneumatic.

XVIII · Renderings

A 'RENDERING' may be defined as a carefully finished drawing, representing a product, machine, package, or other object which has never been made, hence is purely imaginary. Since the purpose of a rendering is to send your ideas forth to your client in their best bib and tucker, it should be carefully prepared, complete in detail, and made from such a viewing-point that it will tell as much of your story as possible.

The layman only half understands the word "rendering," if he has heard it at all. Therefore it is wise to refer to such drawings in letters, agreements, or other contacts with the client as "colored perspective drawings," or perhaps "visualizations."

A rendering is usually drawn in perspective. It may be in monochrome or in color. A good rendering should speak for itself so completely that you need not indulge in additional verbal embroidery to explain it.

Generally speaking, you should make your renderings from a normal station point, that is, the eye should be considered to be located in a logical position with relation to operation or observation of the product in the home, office, or factory. For instance the station point for rendering an electric griddle might be two or three feet away, as if seen from a sitting position at the dining-room table. For a kitchen range, the eye level of the average woman, about 5 feet 1 inch, should be chosen for the horizon and the station point taken eight to ten feet away, or across the kitchen. Similarly an 18-foot drill press should be viewed from the average man's height and perhaps ten or twelve feet away as if he were observing the press in operation.

In order to gain dramatic effect with tall objects it is sometimes permissible to lower the horizon line and bring the station point closer. For example, a refrigerator or a kitchen cabinet might be viewed as if the observer were sitting on a low stool

about 4 feet away. These are tricks that photographers with their "camera angles" have taught us and they may help to make a two-dimensional representation more impressive by reason of the unusual point of view.

DON'T FAKE DIMENSIONS

On the other hand it is absolutely inadmissible to tamper with the actual proportions of the product. The perspective outline from which you make your rendering should be laid out from mechanical drawings that are accurate down to the last sixteenth of an inch. There is no use trying to deceive the public, as some of the motor manufacturers do with their beautiful color drawings of cars stretched out like rubber bands. You will be found out when the models are built, if the project gets that far.

Make use of color whenever possible. A color drawing is not only more interesting than black and white but it will help "sell" your ideas just as surely as color helps sell the eventual consumer. We have at times even made use of movement in a rudimentary way by mounting a cardboard dial or indicator on a rendering and revolving it by hand behind a celluloid window while making the presentation. Devices of this kind are entirely legitimate when they make the demonstration more graphic and exciting.

In some types of products, however, color is rigidly specified; if it is monochromatic, you have little chance to use this helpful aid. Kitchen equipment, after a brief orgy of pastel shades and even colors of brilliant chroma like red, blue, and green, has sobered down to the conventional black and white. All machine tools, by agreement of the nationwide association, are painted a medium bluish gray.

In cases of this sort you have various devices at your command to brighten up the drawings. You may "break in" various colors on the surface of the product itself—warm reds and yellow, soft greens, icy blues—as if they were reflected from something near by. You may make the most of bright colored hardware such as latches on refrigerators, gas cocks on stoves, and control buttons on machinery; you may introduce spots of gay color in name plates or instruction labels. Or you may use plenty of color

in the background, throwing the product out in relief through your knowledge of complementary or recessive colors. Lastly, you may give genuine life and action by sketching in a figure, or hand, or whatever may be appropriate, incidentally giving a sense of relative scale.

THE QUESTION OF SCALE

The scale of the drawing is almost as important as the angle from which it is viewed. Small objects may be shown full size, or what appears to be about full size in perspective. (Remember that if any given dimension in a perspective drawing is shown full scale and the other dimensions are in correct proportion, the resulting picture will seem oversize, an effect to be avoided.) Make large objects as large as practicable, depending on the medium employed. To render an instrument panel for an automobile full size in airbrush would be difficult; it is doubtful if you would be able to find a single sheet of illustration board large enough. Half-size would be reasonable. If your client insisted on seeing it full scale, a commercial photographer having the necessary equipment could blow it up to that size, thus giving an idea of the full scale in black and white, with the half-size drawing to refer to for color.

There is no doubt that a well-executed airbrush drawing in color is about the best kind of presentation drawing that can be made. With the airbrush, you can get effects almost impossible in any other medium. Airbrush drawings are impressive because of their clean and finished quality and, if properly done, they give a professional look to your presentation. The object of the presentation drawing is not to make a "work of art," but to interpret your ideas as specifically as possible. And, in the hands of an accomplished renderer, nothing is quite so specific as the airbrush.

These drawings are costly and tedious to make, however, because the process is indirect and cannot be hurried. In our own work we have almost discarded the airbrush, except for small drawings and special uses; we prefer to show finished scale models. The model can be viewed from all sides, whereas the rendering shows only one view, unless you increase the task by showing it from several different angles.

The airbrush, however, can never be entirely replaced by other media. Therefore this book would not be complete without some description of its technique.

MATERIALS

The materials you will require are as follows:

1. *The airbrush, and the necessary compressed-air source:* There are several good artist's airbrushes on the market. Not every instrument, however, will do the same kind of work. There are models made for photo-retouchers, which handle special liquids and can be controlled to spray exceedingly fine lines. A larger brush for general purpose work will be found to be better for the industrial design studio. A compressor and pressure gauge, or a cylinder of carbon dioxide obtained from a bottling plant will be necessary, unless you happen to be in a building piped with air lines—sometimes the case where there are medical offices.

The airbrush is a precision instrument and must be treated as such. Clean it carefully after each use. Directions are usually given with it, but it is a good idea to take instruction from an expert. If you do not know anyone who can help you, read the directions carefully and practice until the operation becomes automatic. Hold the gun as you would a pencil, pressing the lever which controls both air and color with the forefinger. Do not use the tip of the finger but the part just under the first joint. This makes for more evenly controlled pressure.

2. *Bristol board:* Practically any paper may be sprayed with an airbrush, but for the best results, use a smooth Bristol board or a fine-grained illustration board. Frisket paper sticks better to a smooth hard surface like Bristol.

3. *Frisket paper:* This is a special paper, almost as transparent as cellophane, which may be purchased from any drafting supply house. The paper is exceedingly thin and tough, somewhat resembling fine parchment. It comes in sheets 20 by 24 inches.

4. *Frisket knife:* This is a small blade of fine quality steel, mounted, sometimes removably, in a short wooden handle. Curved and straight shapes can be had. You can make a cutting blade for a compass from a discarded dentist's drill or other fine steel.

5. *Stiff, thin cardboard or stencil paper*: These will be useful for masking after the frisket has been removed, if some hand retouching is necessary.

6. *Small lead weights*: Printer's slugs will do for these. You will use them to weigh down the cardboard or stencil paper when both your hands are occupied.

7. *China dishes*: Any art supply house will carry them. It is well to have a few of ample size.

8. *A large bowl or jar*: For rinsing brushes in clear water.

9. *Assortment of tempera colors*: Artist's tempera is perhaps most useful, but transparent water colors or colored inks may be used, especially in the finer brushes. If it is mixed with too little water, it will not work at all; if with too much, it will splatter. The quality of paints differ widely. Only experience will tell which works best.

10. *A large sable water-color brush*: For mixing paints to the proper consistency and loading them into the cup.

11. *Rubber cement and thinner*.

12. *One 4- or 5-inch flat house-painter's brush*: To spread rubber cement evenly over the frisket paper.

13. *Straightedge or ruler*: Preferably made of metal.

PROCEDURE

a. *Preparation of Frisket Paper*

Lay a sheet of frisket paper, with or without the under papers, on a piece of cardboard and tack it down at the corners with a dab of rubber cement. This will keep the thin paper from slipping around or blowing off. Mix the frisket cement with benzine or other appropriate thinner, to about the consistency of thin sirup. Pour some in the center of the sheet, spreading it with a wide brush, first out to the corners, then over the rest of the paper. Apply it as evenly as possible. This must be done quickly as the cement sets rapidly. When dry, apply another slightly heavier coat and allow it to dry. Always have plenty of frisket paper. It can be kept for weeks in a closed cupboard or drawer. In fact, if properly made, it will be better when several days old than when freshly prepared.

b. Tracing Down the Drawing

The best way to transfer the outline to the Bristol or illustration board is to pencil the back of the drawing, then trace over the lines with a rather hard, sharp lead. Avoid erasures, especially on smooth Bristol, as they sometimes show through the airbrushing.

c. Laying On the Frisket

It is usually best to cover the entire sheet with frisket paper. Cut a piece slightly smaller than the drawing paper, pick it up carefully, and lay the cemented side over the drawing. Smooth it from the center to the four corners first, then smooth down the rest of the sheet, taking care to avoid air pockets and creases.

d. Cutting

Plan each step of the drawing before you start. Use a steel straightedge as much as possible; it saves time, frisket paper, and patience. Cut all the outlines before painting, as sometimes color sprayed on the remaining frisket paper makes it impossible to see the lines underneath (see Plate 4).

Now remove sections to be painted the same color unless they adjoin and require special shading. After painting the first color, remove sections for the next application and cover the first areas with fresh frisket paper, until all areas have been thus protected.

e. Shading

Build up tones by successive sprayings instead of trying to produce the desired color in one spray. This makes for more even tone and better control of values. You can control the brush for amount of air and amount of color independently of each other. Here a word may be said about operating the gun. Do not press the lever down and hold it down while spraying a surface, but press and release at the beginning and end of each stroke in rapid succession as the hand swings like a pendulum across the paper. Thus you avoid streaks and spots and produce a smooth tone.

Shading may be done either by successively heavier sprayings of one color, or with a darker paint to indicate shadows.

Stencils cut from heavy paper help in shading rounded edges and corners where a soft high light would show. (If you are not

sure how a high light or shadow would look on your design, study an object with similar contours.) Spray very lightly, moving the stencil slightly so that a hard edge is avoided (see Plate 4).

f. Backgrounds

When the drawing is finished, remove all frisket paper and cover the painted area with a fresh piece, cutting away the background spaces. Spray the background as desired with a flat solid tone vignetted, or realistically with the necessary colors and shadows, figures, etc.

g. Mistakes

Try not to make any. Avoid touching the airbrushed surface with the fingers or scratching with paper edges. Always test the paint for color, value, and consistency before using it on the drawing. If the color is not too heavy, you can often erase it from an unwanted area. Too dark values may be corrected by spraying with a lighter value. This is dangerous unless very carefully done, for the color sometimes changes when the lighter paint is applied. Or, you can paste down a clean piece of paper, cut to the exact shape of the spoiled area, and paint it correctly. Sometimes a mistake is hopeless. If so, don't waste time on it; make a new drawing.

h. Retouching

This operation points up the drawing and emphasizes details too small to be painted with the airbrush. Strengthen dark lines and edges with colored pencil or with paint loaded by means of a sable brush into a ruling pen. High lights on rounded edges may be suggested by erasing with a hard eraser. Sharp, bright high lights may be painted in with white tempera. This should not be overdone. Try to leave white paper for high lights. Very small areas of color, as in name plates, lettering, or handles, may be painted with a brush. (See Plate 5.)

Making an airbrush drawing is almost as indirect as making an etching. You never know just where you are until it is finished. Of course you could take up all the frisket after each cutting and blowing, just as the etcher melts off the wax and takes proofs or "states" of his plate to see how it is coming out, but that merely

doubles the labor. With the airbrush, due to the fact that the frisket paper protecting certain areas becomes discolored with the paint that is being sprayed on the exposed areas, you are working "blind" most of the time; therefore only judgment and memory will tell you exactly what contrast of values you are going to obtain in the finished drawing. Airbrush drawing takes a great deal of practice. Really top-notch airbrush work is usually done by an artist who has painted in oil, water color, or pastel. He should have a strong sense of form, a subtle appreciation of values, and, of course, a fine feeling for color.

Run-of-the-mine airbrush work, done by the average photo-retoucher, is pretty feeble stuff. Expert as he may be in his particular specialty, his feeling for three-dimensional form is limited. His work has an edgy, "hollow" quality. Plate 5 shows examples of the solid and the hollow variety of airbrush rendering, side by side. The addition of color would bring out the disparity even more clearly.

Rendering bright metal in airbrush, wash, chalk, or in fact any medium, is a difficult thing to do properly. To delineate an object of plated metal which has been given a scratch-brush or so-called "Butler" finish is comparatively easy. Here the high lights are softened and spread over a rather large area; the darks and reflected lights are not unlike those that would result if the same object were finished in a light gray paint with a semimat finish. But the same object plated in chromium or nickel, or made of Monel metal, stainless steel, or polished aluminum, is a different matter. These surfaces reflect neighboring objects almost as accurately as a mirror; but curvatures and irregularities of the surface distort these reflections in a bewildering manner. Furthermore the reflections change under different lighting conditions and different surroundings.

If the object for delineation were already made and could be set up on the drawing board ready to render, the problem would not offer any great difficulties. But remember that your renderings are always pictures of imaginary products, which have no reality save in the sketch you are making.

There is no positive way of taking the guesswork out of such renderings. Practice sketching polished metal objects of various shapes and contours to familiarize yourself with the way in

which high lights and reflected objects behave in these mirror-like surfaces. (Plate 24 shows a teakettle in which the entire room is reflected.) Gradually you will acquire confidence and be able to delineate imaginary shapes with approximate realism. The contrast of values in a curved piece of bright metal is so extreme that it is a practical impossibility to render them exactly. The high lights are even brighter than the source of light that causes them and the darks are darker than the object reflected.

OTHER USES

Whether or not many complete airbrush renderings are made in your studio, the uses of the airbrush are so many and various that it would be difficult to conduct a design business without one. It can be used to touch up drawings made in colored pencil, hard pastel, or water color. It is useful in the preparation of name plate comprehensives. It will help give "atmosphere" to almost any drawing which, through too careful and painstaking delineation of details, needs softening. It may also be used to give variation to plane surfaces in conjunction with hand-brushed tempera renderings and renderings made from colored artist's papers pasted onto a background (see below).

TEMPERA DRAWINGS

Tempera applied with brushes is useful in preparing renderings of products with large flat surfaces. A heavy illustration board must be used for this purpose, otherwise the moisture in the paint will warp and wrinkle the drawing. Tempera painting has been carried by some artists to a high degree of technical finish and it can be, in expert hands, a beautiful medium. Being opaque, one color can be laid over another after the first coat is dry, somewhat like painting in oils, although colors cannot be blended *on* the surface as with oils. It is an excellent medium when crisp and forthright effects are desired. For an example of tempera rendering, see Plate 6.

Once an area has been laid in with an even, flat wash, you can load the same pigments, lightened or darkened in value with white or complementaries, into the airbrush cup and spray them over the flat surface to give slight variations of tone and consequently more life to the drawing. You can soften an edge or cor-

ner by this means, whereas it is extremely difficult to manipulate tempera on the board to give these effects of variation without smudging and "pooling" of the pigment.

For outlines, sharp high lights along edges, lettering, and other detail, load the tempera into a ruling pen with your brush and trace along the edge with a ruler, triangle, spline, or French curve.

COLORED PAPERS

Another type of rendering that you will sometimes find useful is the drawing made by cementing areas of artist's colored papers or label stock down onto Bristol or illustration board. The best grade is known as the "Bradley papers," made especially for commercial and industrial artists and package designers. There is a wide range of colors, covering by equal gradation of steps all the spectral hues, with many variations of value and chroma. Each color is numbered and a convenient color index in the form of a small pad provided.

These papers are usually used for renderings in elevation only where there are broad masses of flat color, seldom for perspectives. You might, for instance, wish to indicate the fabrics to be used on the cushions for a set of steel porch furniture. Trace down an elevation view of back cushions and seat on the Bristol board, cut the Bradley papers to the proper outlines with a frisket knife or scissors, and fasten the pieces down with rubber cement. Then paint in the fabric pattern with tempera, and soften the edges, to show the contours of the cushions and the wavy character of the surface, with the airbrush. By masking the entire drawing, you can again use the airbrush for a background of any desired color.

EXPLANATORY DIAGRAMS

If you have decided to make your presentation in the form of an airbrush or chalk rendering, or a tempera or "paper" sketch, leaving the scale model to a later date, it may be advisable to have additional ammunition in the form of explanatory diagrams or details showing certain phases of the design which will not be visible in the rendering. Some designers prepare a complete set of finished dimensioned drawings to accompany the rendering or

model as the case may be; this seems to me a little premature for reasons to be given later.

Of course you will have had to make rough layouts on the drafting board, to scale, with the necessary dimensions, in order to prepare either a perspective rendering or a scale model. But projects seldom go through unchanged, even when they have been brought to the point of making these almost final gestures. Therefore it would seem better to wait until the product had finally jelled before nailing down every last radius and fillet, every final contour and dimension, in the form of a complete mechanical drawing.

The rendering or scale-model stage of an industrial design project might be compared to a house half built. The foundation has been dug and its masonry completed. Uprights and joists are all in place and the sheathing and flooring done. But although the structural outlines are set and no major changes will probably be made, the structure is still fluid enough to alter the type of cornice, the details of doorways, the style of exterior finish and roofing.

One good way to take the curse off the frozen and irretrievable quality of the finished rendering is to make certain variations in the form of outline pencil tracings, in perspective, to the exact scale of the rendering. In these, you can show variations of detail, attaching them to the rendering as flaps, which can then be dropped over the colored picture. We frequently provide graphite sketches, as alternatives to the finished color rendering, even at this late stage of the game.

MATTING

The physical preparation of the rendering should be described briefly. If your drawing is good, it deserves a good setting or frame. The effect of your presentation may be spoiled by slipshod matting, smudged cover flaps, in fact any evidence of carelessness. When your drawing first greets the eye of the client it should be as immaculate as the summer dawn.

Drawings made on charcoal paper, thin Bristol board, or any other easily creased material should first be mounted on a piece of stiff cardboard. Avoid pasting or mounting with rubber cement; it is unnecessary, and changes, called for after the matting is completed, are difficult to make. Cut the mat first, then

locate the drawing within the frame made by the mat so that it shows to the best advantage. Then remove the mat and fasten the drawing to the backing board at four corners with short strips of cellulose tape, which can be bought in rolls and mounted in an inexpensive and handy dispenser. Then lay a sheet of medium-weight cellophane, the same size as the drawing, over the picture and fasten it down in like manner. Always cut the mat opening slightly above center, because of the familiar optical illusion that a drawing or photograph mounted in the exact center of its frame always appears to the eye to be below center. (See Chap. XI.)

Materials and colors for the mat must be left up to your own taste and judgment. Small drawings do not need a particularly heavy stock, but large sketches are best framed with a fairly heavy matboard, which will add stiffness and body. There are various weights of cellophane too, but it is best to select one of the medium heavy grades, because the lighter varieties, even if "moisture proof," tend to wrinkle and pucker with temperature changes and humidity. If you wish to indulge in the last word in "dog" you can use a heavy double mat, fastening cellophane that has been kept in a moist place between the two layers. When brought into a drier atmosphere it will stretch tight as a drum and form a window like glass.

Finally, place the mat over the backing board and fasten it down with rubber cement or vegetable paste. Binding the edges with passe partout gives a certain finish and is indicated when the drawing may receive pretty hard usage which causes the edges to fray or break.

A cover flap (again texture of paper and color is for your personal decision) should then be cut somewhat oversize all around. Place the matted rendering face down, fold the top back, then cement it. With the mat still on its face trim away the excess, using the edge of the mat as a guide.

A signature or other device, either drawn in pencil or crayon, stamped on with a rubber stamp, or affixed in the form of a printed gummed label, is the final flourish. You may put it on the mat itself or on the cover flap.

XIX · Presentation Models

THE PRESENTATION model is the climax of your labors. If it “goes over,” your work is by no means ended, but the remaining activities—the dimensioned drawings, the finished comprehensives of name plates and patent plates, the color specifications, and the supervision of the full-size models—constitute a definite slackening of pace.

The presentation model represents your final recommendation to the client. Here, then, is the place where no effort should be spared to obtain the last word in perfection of finish and minuteness of detail. Therefore, since the preparation of it is expensive and takes great skill and patience, it should not be attempted prematurely, that is, before the project has been brought to the point where the general scheme has received the approval of executives and engineers and most of the problems of manufacture, assembly, and approximate cost have been reasonably worked out.

The advantages of a model over even the finest airbrush rendering have been mentioned in a previous chapter. It will do no harm to reiterate that a model can be viewed from every angle, can be lighted effectively, and will give a better idea of finish and the exact effect of high lights and shadows than the most carefully prepared drawing. Further, it can be photographed against a plain background in such manner that direct comparisons can be made with photographs of former machines (see Plates 10 and 11).

We had the curious experience of having an eighth-scale model of a large press, which we had designed, photographed by the client and the photograph used in advertising and publicity before the first machine was even assembled. Obviously the manufacturer had to be pretty sure of his engineering in

order to take such a chance; it is hardly a procedure to be recommended in many cases, and never with consumer goods.

WHAT SCALE?

The question of scale is important. Generally speaking, your model should be as large as practicable. A full-size model is always preferable and, even though the product under consideration is so large that the model must be made to a fractional scale, the wise manufacturer invariably builds at least one, sometimes many, full-size mock-ups first of wood, and finally in actual metal, during the course of a major design program. Full-size models of large products, however, should not be expected from the designer, whose facilities are seldom adequate to construct them.

Among products suitable to preparation of full-scale models in the design studio would be toasters and griddles, electric irons, percolators, desk lamps, typewriters, vacuum cleaners, cameras, check registers, adding machines, table radios, counter scales, coffee mills, and many other items of like size. Accessories and parts such as washing-machine and stove legs, escutcheons and dial groups, levers, knobs, and handles—in fact anything pertaining to a large product which can easily be handled in your own model shop—should always be made full size.

Larger equipment, such as refrigerators, ranges, home laundry machinery, air-conditioning apparatus, stokers, furnaces, machine tools, and tractors will have to be made one-half, one-quarter, or one-eighth scale—whatever is the most manageable and most transportable size without undue danger of breakage. Avoid odd scales, such as three-eighths or three-quarters, not only because they are more difficult to make, but because at a presentation meeting clients often want to scale off measurements from the model and may not have special scales or rulers available.

The small-scale model of a large product has a definite psychological advantage. Most people love a “miniature.” This is borne out by the general interest in ship models, toy trains, and small-scale interiors. The very contrast in size with some familiar original shocks the mind to attention. Time and again we have galvanized a gathering of executives into immediate

attention and curiosity by unveiling a beautifully finished small-scale model. Even clients who have been indifferent towards a design already seen in the form of a finished perspective drawing may warm up surprisingly when a model is put before their eyes in all the glory of its three dimensions.

There is one drawback, however, to the small-scale model. It is sometimes deceptive and must not be relied upon too implicitly for the refinements of proportion and balance—those subtle interrelations of form that make or break final appearance. Nothing will replace the full-size mock-up. A cabinet leg which looks sturdy enough in miniature may seem flimsy when enlarged proportionately to full size. A name plate may seem in perfect scale on the model yet look like a billboard on the final product. Once we were preparing a quarter-size refrigerator model. Due to an error in dimensions on the model layouts, the miniature door handle was made considerably longer than it should have been, but with model completed and handle affixed it looked quite satisfactory. No one in our office noticed the discrepancy in scale. But when the full-size handle model was begun, we immediately realized that, if attached to a full-size cabinet, it would seem as big as all outdoors.

Occasionally you can skip the small-scale model entirely. Your client may decide, after examining your renderings and clay studies, that he would like to build a full-size model at once. You must then supply his pattern shop with completely dimensioned drawings, marked "for wood (or handmade) model only." But beware of this procedure if the product is at all complicated or involves many freehand forms. No matter how complete and accurate your drawings, slips are bound to occur, and you must follow every step carefully to see that the final result correctly interprets your scheme.

FIVE STEPS

Let us recapitulate, outlining the successive steps involved in a well-integrated design program as far as model work is concerned:

1. Clay or wax studies; prepared by the designer.
2. Rough dimensioned layouts; taken from the above by the designer as a guide to his model maker.

3. Presentation model; prepared by the designer, full size if possible.

4. Full-size dummy model or mock-up; prepared by the client from drawings supplied by the designer, difficult parts to be cast from patterns copied from plaster casts supplied by the designer.

5. Full-size working model; prepared by the client and made in metal or other final materials to be used. Usually built from hand-machined parts, castings made from temporary wood patterns, freehand sheet-metal forms swaged on blocks.

We have already described the steps necessary to produce a fairly accurate study in modeling clay. The technique of making presentation models is much more exacting and demands a higher degree of professional skill. The latter may be divided into four groups:

1. Models built up from separate plaster pieces and assembled.

2. Models cast in plaster from a clay or wax original.

3. A combination of both.

4. Models carved from a single block of plaster or other materials.

The materials generally used in the construction of all types of presentation models are as follows:

TOOLS

| | |
|-----------------------------------|---|
| Vise | Grease brushes |
| Hammer | Wire brush for cleaning files |
| Saws for wood and metal | Pans for mixing plaster (several sizes) |
| Pliers | Spatula |
| Screw drivers | Trowel (with straight sides) |
| Wrenches | Spoons |
| Brace and bits for wood and metal | Plaster scoop |
| Spirit level | Sheets of plate glass |
| Electric soldering iron | Wooden straightedge |
| Assorted files | At least one steel square |
| Scrapers made of sheet steel | Several celluloid triangles |
| Clay-modeling tools | Calipers |
| Wood-turning tools | Dividers |

| | |
|---------------------------------|---------------------|
| Wood carver's tools | Small plane |
| Diemaker's files | 6-foot rule |
| Spray gun | Drawing instruments |
| Paint brushes of assorted sizes | Beam compass |
| Plaster brushes | |

SUPPLIES

| | |
|--|---|
| Modeling clay | Masking tape |
| A good molding plaster | Sheet brass, .005 inch thick |
| Lumber; any soft wood easily workable, for armatures, etc. | Glue, rubber cement |
| Pattern-maker's white pine or mahogany, for wood turnings | Casein paint |
| Wood doweling | Lacquers |
| $\frac{1}{4}$ -inch plywood | Enamels |
| Cardboard | Shellac |
| Wire (several sizes) | Lacquer thinner |
| Solder | Turpentine |
| Sheet zinc | Alcohol |
| Benzine | Kerosene |
| Paraffin | Beeswax |
| | Sheet celluloid |
| | Nuts, bolts, screws, nails, tacks, etc. |

MODELMAKER'S GREASE

Many different kinds of grease can be used for casting. Ordinary cup grease or vaseline will give fair results, though it is usually too thick and must be diluted with a thin oil or kerosene. The grease commonly in use in casting shops is composed of commercial stearic acid and kerosene.

Good results can be obtained by using a grease composed of:

$\frac{1}{4}$ pound of beeswax
1 pound of paraffin
3 pints of kerosene

Heat these together in a double boiler until the wax melts; it will be ready for use when cool. The proportion of kerosene to wax should be varied according to the weather and type of work you are doing. This grease may be thinned, without reheating, by adding kerosene.

1. BUILT-UP MODELS

In most of your work, this type of model will probably be indicated somewhat more often than the cast model, although that depends on the class of work you handle. Products or machines utilizing the usual processes of sheet-metal fabrication will lend themselves to construction by the built-up method.

These processes result in geometrical forms, regular radii, and compass curves. Machining of dies is expensive at best and geometrical forms are more economical than freehand forms. Sandcasting, stamping, plastic molding, and spinning are much more flexible; therefore, models of such products may be either cast in plaster or built up.

To construct a successful built-up model, you are beyond the stage where you can experiment, changing as you go along. Guesswork won't do. Consequently you must nail down all dimensions to the last thirty-second of an inch. The drawings from which you work need not be so carefully prepared as the final mechanical drawings, but even though sketchy, every dimension affecting the exterior must be accurately shown and they must all check out correctly.

Your first job is to study the drawings, analyzing them to determine the simplest and most direct way to construct your model. A previous clay study-model may be at hand to help visualize it. At this stage you are like the general of an army who sends out reconnoitering parties, consults maps of the enemy terrain, and plans his campaign accordingly.

Let us take as an example a comparatively simple form, a domestic refrigerator. Figure 148 represents the product as it will finally appear.

Analyze this to determine how many slabs of plaster you will have to use. Since the model is to be shown with the door closed, the entire body can be hollow, reducing weight and drying time. Figure 149 gives the result of your study, indicating that five pieces will be required. Four of them will have to be "run" in wet plaster with templates filed to conform to the sweep of the parts in question. (The process of "running" the plaster will be described later.) The fifth, the back piece, can be made from a flat slab of plaster, cut to fit. Leave the bottom open. Since the

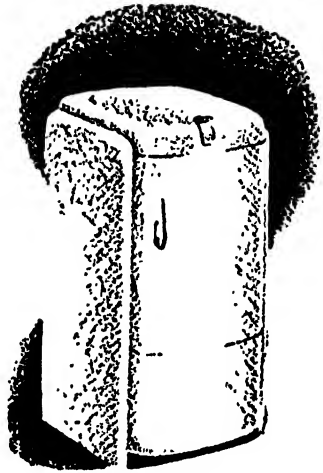


FIG. 148.

two sides are identical, run them in one slab twice as long as the height of the cabinet, then cut it in half.

Let us begin with this piece and describe the procedure step by step. The model is to be made quarter size. The total height of the cabinet according to manufacturer's specifications is to be 5 feet 6 inches. Therefore, the finished model will be $16\frac{1}{2}$ inches. The average thickness of plaster slabs on models of this size would be about $\frac{5}{8}$ inch, although the $\frac{3}{4}$ inch set-back for toe space will necessitate making the front slab one inch thick or more.

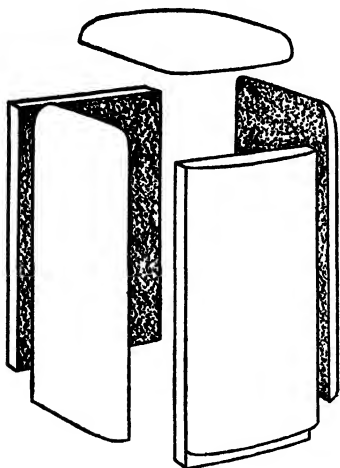


FIG. 149.

If you are working on a wooden table, fasten down a wooden straightedge with a couple of nails and shove a sheet of glass up against it. Place a few small nails at the edges of the glass to keep it from sliding back and forth or away from the straightedge. If a slate or marble-topped table is avail-

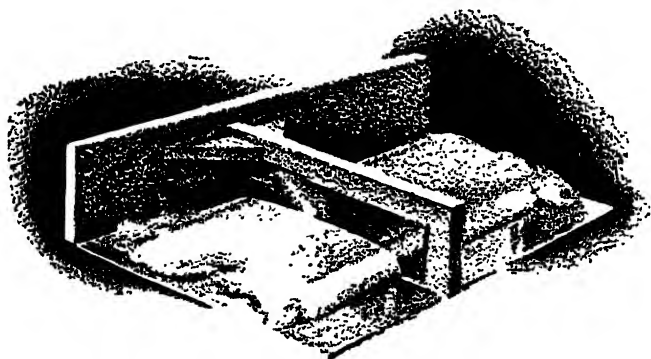


FIG. 150.

able, you can place the straightedge upon it and clamp it firmly in position at both ends, the sheet of glass then being unnecessary. Next cut out a zinc template to the contour of the side of the

refrigerator, making it the $\frac{5}{8}$ inch depth allowed for the side slabs. As zinc is soft and bends out of shape easily, it should be backed with wood, and braces will be found necessary to make it run smoothly and evenly against the straightedge (see Fig. 150). Keep the wood backing about $\frac{1}{8}$ inch back from the cutting edge of the zinc so that the former will not come in contact with the plaster.

Mark off on the straightedge a distance a little more than twice the length of one of the side slabs to determine the length of the piece that must be run. After greasing the straightedge and the template, you are ready to mix the plaster.

Put a quantity of water into a pan and sift the plaster slowly into it (a large sugar scoop is useful for this purpose). As the plaster settles to the bottom of the pan, continue the sifting process until there is but little free water left above the saturated mixture. Do not stir until all of the plaster has been soaked with water. The amount of free water left on top determines the thickness of the mix. The first batch should be quite thick, which means that you should give the water about all the plaster it will soak up. Then stir it with a beating motion, keeping the spoon constantly below the surface of the mixture. Fast and thorough mixing will hasten the setting. In any case you must wait until the plaster is thick enough to use. Then ladle it out onto the glass where your template will be run. As it thickens, run the template over it, scraping off the high spots. Add more plaster in the low spots and run the template again. Repeat this process until the slab is perfectly formed to the contour of the template. As the plaster becomes too thick to work, make another and somewhat thinner mix. The number of mixes necessary will depend upon your skill and the shape of the section.

When the template has been run through for the last time, take the slab up and set it aside to dry; placing it on a radiator will help to drive off the excess water. (Wherever you put it to dry, take care to see that it lies on a level surface or is supported at frequent intervals along its length, since plaster warps or bends easily when wet.) Thus in one run you have formed the two sides of the refrigerator.

The front is made in a similar manner, and the top likewise, with different templates of course. Since the top curves in more

than one plane, only one of the curves can be *run*; the other must be *carved* in afterward.

The back slab, having no curves, is a simple matter. Place four well-greased sticks of the required thickness on the glass slab to fence in the required rectangle. (Gobs of modeling clay will serve to hold the sticks in place and stop up the cracks between them.) Fill this space with plaster and, when it has thickened, strike the top off level with a straightedge.

Now, after sawing your double-length slab in two, you have the five pieces necessary to construct the model. This is merely raw material and from now on the work becomes more exacting and delicate.

First square off the side, front, and back slabs and reduce them to the exact length needed. If you have a sanding disk and table, this will take but a minute or two; it can be done with a plane and scraper, but requires more time. Since there is a setback of 3 inches for toe space at the front of the refrigerator, cut this into the front slab. Scrape in the division line between the upper and lower doors with a small template and a straightedge. Then stand the four pieces upright on the sheet of glass in their correct relative positions. After testing with a square to see that all pieces are standing perfectly plumb, fasten them together.

Place a little water in a saucer or shallow pan and drop a spoonful of plaster into it. Don't stir the plaster, but let it gradually soak up water. Take a small blob of soaked plaster up on the bristles of a long-handled brush and place it in the angle at the intersection of two of the pieces. Repeat this until all the pieces are caught together in several places. Plaster may then be brushed more freely into these inside angles until the pieces are thoroughly stuck together the entire length of the joints. As the fresh plaster must be thoroughly set before you can handle the now partly-assembled model, it should be allowed to stand while you turn your attention to the top.

Let us assume that the section that was run is through the center of the model from front to back. As the front and sides of this model are curved it is obvious that the top slab can be correct in section only on the center line, so that the remainder of the forming on this slab must be done by means of free-hand carving or scraping with additional templates. After cutting off the rough

ends and reducing the slab in length to just a little more than its finished dimension, place it in correct position on the partly assembled model and trace on its under side the contours of the front and two sides of the model. Again the sanding disk comes in handy, for you can sand the sides and front of the slab down to these lines very quickly, finishing up with a flat file. Now, from the plan view, our slab is correct in its contours. Referring to the front elevation of our drawings, however, we shall find that there is a radius at each side of the top and a gentle curve over the entire top connecting the two radii, as in Fig. 151. With a wood carver's gouge rough out these radii, then scrape them with a zinc template made for the purpose, and finish with a file and sandpaper. The gentle curve between the radii can be roughed out with a chisel or a flat gouge, then filed and sanded.



FIG. 151.

The top now conforms with your drawing of the front elevation. Since the original section was run with a template made from the drawing of the side elevation, the top will be correct in that respect, at least on the center line. You find however, that in cutting the top to the curve of the front you have ruined the radius at every point except on the center line. You must therefore recut this radius between the center line and the front corners, using gouge, template, and file as before. You are then ready to affix the top to the assembled sides, front, and back, which by this time should be thoroughly set.

Now place the top on the glass with the curved side *down*. (Use wedges to keep the slab from rocking and to hold it in a reasonably level position.) The rest of the model can then be assembled, upside down, and stuck with fresh plaster as described before.

When this has set you are ready to point up the cracks where the slabs come together. This may be done either by brushing plaster into the cracks or forcing it in with a penknife or spatula. Sometimes you can finish the joint by carefully smoothing it over while the plaster is still wet. As a rule, however, it is better to heap fresh plaster up a little above the finished surface, allow it to set, and then cut it down with a carving tool or file and a little

sandpaper. At this time you must also fill all air holes, scratches, and other defects with moist plaster. Before being painted, the plaster must be thoroughly dry.

Finishing

In preparing models for finishing, casein paste paint is very useful. You can mix this paste to any desired consistency by merely adding water, or use it in its original form for filling scratches, small air holes, etc. It dries quite rapidly and can be sanded to a smooth, polished surface with fine sandpaper. Two or three coats of this, sanded after each coat, should prepare the model for its final finish.

Inasmuch as a high gloss finish is desired to simulate synthetic enamel and all parts of the model are easily accessible, apply the lacquer with a spray gun. The first coat should be light to avoid runs. After this is dry, apply a second and somewhat heavier coat. A third coat, still heavier, should ordinarily complete the painting operation. Since the contours of your refrigerator model are rounded, with no fine detail to be lost in the application of too heavy a coat of paint, a fourth or fifth coat could be used to advantage. In any event when the painting is completed the surface should have the appearance of a fine piece of porcelain.

If any of the applications are too heavy and the lacquer runs, let it dry thoroughly and sand the defective areas to a smooth finish before applying the next coat. It is a common error to use paint too thick for spraying, which results in a textured or "orange-peel" finish. Most lacquers need the addition of an equal amount of thinner to bring them to a good spraying consistency. Air pressure of about 40 pounds usually gives good results. If the spray is properly adjusted and no runs occur, it won't be necessary to sand between coats of lacquer.

You are now ready to consider the hardware, name plate, and other details. Let us assume that your design calls for a piano hinge on the door. You may represent this by a piece of wire of the proper gauge, either chrome-plated or coated with aluminum paint. You may carve the door handle from a piece of wood or plaster, or actually cut and file it from a piece of brass and plate it. The manufacturer's name plate can usually be lettered on a

piece of colored or metal paper with tempera paint and then sprayed with clear lacquer to protect it from dirt and moisture. Often the completion of such details as this takes as much time as the building of the main mass of the model, but upon them depends much of the final effect; their psychological value cannot be overestimated.

When the design has been accepted, and your client is building full-size models, you will make hardware, name plate, and hinges full size in your model shop, together with many interior details. For this model you will probably make the door handle in clay, then cast it in plaster, or cut it directly from a block of plaster. Because of greater accuracy, the latter method is to be preferred in cases where the model is to be sent directly to the diemaker as a guide in making his dies, or used to make a master pattern for a sand casting.

Some full-size models for hardware, such as handles, dials, and escutcheons, are made directly in plaster from drawings, omitting the clay study. This is done either because the designer is sure of the result and wishes only to convey his idea to the client, or because the detail is too small in scale to be expressed in the softer medium.

The ideal way to present metal items of this kind is in the actual metal from which they are to be made. They can then be mounted on the manufacturer's mock-up and held in the hand, turned, or otherwise put through their paces. This can be done by making the plaster model slightly oversize, to allow for shrinkage, and having it sand-cast. A good molder with the proper sand can make a casting which, when filed, buffed, plated, and polished, will be the equal of any die casting. This type of model leaves no doubt in the client's mind as to the final appearance.

When this procedure cannot be followed, the next best thing is to finish the plaster model to look as nearly like metal as possible. One way of attaining such a result is to spray it with clear lacquer and, when partially dry but still tacky, to brush it with aluminum powder. The powder will adhere to the lacquer but, being free from any coating, will give a higher luster finish than if it were mixed with the lacquer. You can get an even better polish by giving it a light buff on a soft wheel. Spraying on a

mixture of the powder and clear lacquer (to which has been added a high percentage of thinner) will give a finish almost as good.

Full-size name plates and trade-marks can usually be painted on metal-coated paper with tempera paint, or on a thin sheet of metal, and sprayed with clear lacquer, as in the scale model. Dial glasses, if not curved in more than one direction, may be simulated by the use of sheet celluloid. Convex forms call for the use of Lucite or other transparent plastics, turned on a lathe.

2. CAST MODELS

The technique of casting a model from a clay or wax original differs in no essential way from the process used in casting a piece of sculpture. Various textbooks on the subject describe it in much greater detail than can be given here. However, the average problem met with in industrial design is likely to be much simpler than casting, let us say, a bust or a full-length human figure. Let us attempt, therefore, to describe the various operations involved in making a plaster cast from a full-size plasti-

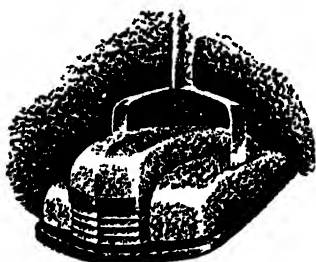


FIG. 152.

lene model of a vacuum-cleaner body, which involves soft rounded forms and will eventually be cast in some alloy of aluminum by sand-casting, permanent mold, or die-casting.

In order to produce a good plaster casting, your clay original must be finished with great care. The better the job of clay modeling, the better the resulting plaster replica and the less hand finishing and patching you will have to do.

When you have prepared a clay study model, it is sometimes debatable whether it will be best to cast the presentation model from the original study or to start from scratch and build an entirely new model in plaster. Much depends upon the nature of the design as well as the care with which you have made your clay model. Casting is usually indicated where freehand contours predominate, but it can often be employed to advantage on models consisting entirely of flat surfaces and mechanical curves if too many pieces are not required in the mold.

Figure 152 represents the finished machine. Your first job is to prepare a plaster mold, or negative, from which the final casting will be made. First analyze the clay original to determine how many pieces will be required for the mold. The forms should be divided up so that the smallest number of parts are needed. These must fit together perfectly to receive the poured plaster which will eventually harden and form an exact replica of the clay original.

Be sure to model the clay carefully so that it is symmetrical about the center line. In Chap. XIII the method of checking one side against the other was described in some detail. Smooth out bumps and hollows in the clay surface to as smooth a finish as possible. Your analysis now shows, in order to "draw" properly and permit the final casting to be removed from the mold without breaking, that you need four pieces, divided as shown in Fig. 153.

After fixing the boundaries of these divisions carefully in your mind, erect small metal fences upon them. This is done by cutting out pieces of thin sheet brass to conform as nearly as possible to the various curves of the model, then pushing them part way into the clay so that they stand out about an inch from the surface. You now have the four parts of the mold clearly defined, and you are ready to begin the work of casting the pieces one at a time. Note that the pieces are numbered in the order in which they are to be cast.

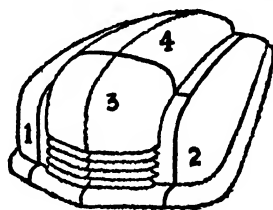


FIG. 153.

The next step is to mix the amount of plaster necessary for the first piece in a pan or bowl and allow it to stand until it just begins to thicken. Then splash part of it onto the model so that it makes a thin coating about $\frac{1}{8}$ inch thick over the entire area of the piece you are casting. (A spoon, spatula, or small wooden paddle may be used for this purpose.) After the clay is covered and the plaster in the bowl thickens, apply it with a trowel or spatula until a fairly even coating $\frac{1}{2}$ inch to 1 inch in thickness is attained.

Since piece 2 has no common boundary with piece 1, you do not have to wait until the plaster of the first is set before beginning work on the second. In fact both of these pieces could be made at

one time by an expert caster, but it would not be advisable for the beginner to try this. Instead, put the second piece on in the same manner as the first and when it has set you are ready to take out most of your metal strips. Remove all of the fence except the part forming the common boundary between pieces 3 and 4. Smooth the model over where the metal strips have been removed, grease the sides of the first two pieces, and cast the other two between them. After piece 3 has been cast, the last of the fencing can be done away with and the last piece cast with the other three forming its boundaries.

When the plaster in the last piece has set, remove the four pieces from the model and set them up on a sheet of plate glass in their correct relative positions. Then stick them together by means of fresh plaster applied to the joints on the outside in much the same manner as you assembled the pieces of the built-up refrigerator model. Do not bother to fill the joints on the inside of the mold, as these will make only small ridges on the casting which can easily be scraped or cut off. Next, apply a coat of shellac to the inside of the mold and, when this dries, grease it thoroughly. You are now ready to pour the casting.

You have your choice of making a hollow or a solid casting. If the casting were to be solid you would simply pour the mold full of plaster and strike it off level with a straight edge when it had become partly set. In this case, however, you have decided to make a hollow casting because it will be lighter and will dry more easily.

Pouring a small amount of plaster into the mold, pick it up and rotate it so that the plaster travels over the entire inner surface of the mold leaving a coating behind it as it moves. Continue this, pouring in more plaster and building up a heavier coat as the mixture becomes thicker. When it is too thick to handle in this manner apply it with a spoon or trowel, building the coating up to $\frac{1}{2}$ inch or more in thickness. Striking off the top with a straightedge, let the cast become thoroughly set before removing the mold. After the cast has stood 15 or 20 minutes take a chisel and cut away the plaster binding the pieces of the mold together. Having removed all of this, drive a chisel into the crack between two of the pieces thus prying one of them loose. By this means you can remove all of the pieces but one. The last one can be driven off with a hammer and a block of wood.

Having removed the mold from the cast, inspect the latter carefully. An inexperienced person would probably be shocked to discover that surfaces he thought nearly perfect in the clay model now appear to be full of bumps and hollows. This is due not to lack of fidelity in the casting, but to the difference in color and character of the materials. These irregularities are not so noticeable in the soft gray green of the clay as in the merciless white of the plaster; and it must be borne in mind that if this model were finished at once in bright aluminum paint they would be even more noticeable. You will also discover a number of air holes in the casting as well as ridges where the pieces of the mold came together. These ridges can best be removed while the cast is still wet and comparatively soft. Fill the holes also at this time. Then dry the cast out by placing it on a radiator or in an oven with a low fire. When the plaster is dry, go over the surface with files and sandpaper to remove all irregularities. The model can then be painted with casein paint and finished in the same manner as the built-up model previously described.

3. COMBINATION MODELS

Frequently the two methods described above will be used in a single model, and the parts assembled. The procedures are the same. If the plaster is quite dry, you can fasten them together with china or airplane-model cement. A better way when conditions permit is to cut grooves across the joint, lay pins or pieces of stiff wire in the grooves, and fill with wet plaster. Doweling or even nailing may be resorted to under some circumstances. The latter is best done, however, before the plaster is dry. After parts are joined in proper location, you can make fillets by loading on plaster in the angles formed by the juncture of the parts and before it has completely set, scraping with a zinc template filed to the proper radius.

For the preparation of small and medium-size models, plaster is the most satisfactory material. It can be worked easily and it is hard and smooth. Plaster is much easier to patch and alter than wood. For spherical and cylindrical parts, however, such as knobs, tubes, etc., wood turned on the lathe may be quicker to make and stronger.

It is unwise to try to use wood and wet plaster together. Even if the wood is well shellacked before coming in contact with

the moisture, it will be only a matter of time before expansion and contraction of the wood in varying humidities will cause the plaster to crack away.

For small objects to be manufactured in synthetic resins, your model shop may be called upon to make models full size in some plastic material. The thermosetting plastics, such as most of the phenolic and urea-formaldehyde compounds, are too brittle to be of value. But they may be simulated in various cast phenolics, cellulose-acetates, polystyrenes and the newly developed acrylic materials such as Lucite. The latter, almost as transparent as glass, can even be turned out on the lathe to represent wine-glasses and tumblers that can hardly be told from actual crystal, except for the weight and flexibility. Nearly all of these materials can be obtained in rod or bar stock in various lengths, and some can be bought in solid blocks of almost any desired thickness as well as a large variety of colors and degrees of translucency.

In machining synthetic materials, take great care not to work the material at too high speeds, for the friction created may heat them to a point where their structure and character are destroyed.

4. CARVED MODELS

Occasionally you may be called upon to provide models of lettering, floral designs, surface patterns in relief, etc., which would not come under any of the above headings, but rather would be analogous to wood or stone carving. If the relief is high and the forms rather bold, you can model the design in clay and make plaster casts in accordance with the procedures outlined above. If fine detail is involved, however, the modelmaker may be called upon to cut the design directly in plaster with chisels and gouges. In this case he works very much like a wood carver and uses much the same tools, although his material is a slab of plaster, cast with as smooth a surface as possible, and carefully prepared to avoid air holes or other imperfections. If the pattern involves a regular repeat you may save yourself a great deal of work by carving only one section in plaster, making a mold, casting a number of pieces from this, and then piecing them together.

Such models are sometimes required for articles to be made by die-casting, rubber-mold, or plastic-mold processes. Therefore,

carve your model as it will appear in the finished piece, then provide the client with a plaster cast taken from this original, but showing the design in reverse. From this the diemaker prepares his dies or molds, reproducing the plaster piece faithfully in steel, beryllium copper, or other material. Plate 11 shows the original design for a rubber heel, carved and cast in plaster three times the size, and later reproduced in steel on a pantographic machine.

XX · The Presentation

THE INEVITABLE moment always arrives when the presentation must be made. You have toiled in the privacy of your own office, perhaps many miles from your client. The executives, presumably, have seen nothing of what you have been doing. Two weeks, a month, six weeks have passed since you left the president's office with an agreement in your pocket. With you the problem has been an everpresent one, and you have seen your first perplexed efforts shape into a design which, to you at least, seems far-reaching, radical, beautiful. You have studied the merchandising setup and worked with the agency. You have been in frequent contact with the client's engineers. You feel that the major features of your design are practical, and that, within this general framework, details can be worked out satisfactorily.

With the president or the sales manager or whoever is most deeply concerned with improving the product, the problem may also have been an everpresent one. Sales have been slipping, the men in the field have been bombarding the home office with complaints that buyers won't buy because the product looks old-fashioned, hasn't the modern "streamlined" touch.

The presentation of your first ideas is awaited with ill-concealed impatience. There still remain many natural and reasonable doubts that you will be able to do much with this particular problem. Therefore, the manner in which you conduct this meeting, the way you put on your show (for you must be the stage manager with your drawings as the star attraction), will have much to do with the ultimate success of the project.

ONE OR MANY

There is much difference of opinion—and naturally so because personalities and methods of approach are as diverse as the sands of the sea—on the subject of presenting designs to the client.

One of America's leading designers believes that the entire job should be completed before anything at all is shown to the executives. He shows but one drawing or model, and that drawing or model is it. He even makes complete mechanical drawings before the client has seen a thing. Then he fights for it. Another designer, equally well known, presents as many as a dozen tentative interpretations at a single sitting.

It is my belief that a happy medium between these philosophies is much the wiser course in the average case. If you are incredibly prolific you can whip together a dozen refrigerator designs, all of which may have some merit. But it seems to me far better to leave the less likely solutions in the rough visualization and study-model stage, then concentrate your efforts towards producing two or, at the most, three presentation drawings for the first meeting.

The theory that there is one ideal solution and that this should be carried to the last ditch before the client has a look, seems to me impractical and even rather poor policy. For one thing, your client is only human and likes to exercise his prerogative of making a choice. Furthermore, who is to say that you are always right, even in your choice of your own sketches? Sometimes painters and sculptors are poor judges of their own creations, preferring works that time proves mediocre. The take-it-or-leave-it attitude is one that has given industrial design a bad name in some quarters.

At the outset you should take the position that you are there to learn and to help, not to dictate. Do not forget that you may delay production to a dangerous degree if you wait too long. If, after the long period necessary to develop your design to the point of finished models and completed mechanical drawings, it is not acceptable, it may put your client in a difficult position. He may have a dead line to meet; production schedules may be waiting; there may be an annual trade show in that particular industry; the company may be planning a preview for its own sales representatives. Many design programs are begun too late anyway and usually you have to work against time because the season for the introduction of a new model is approaching.

Therefore it would seem only sensible for you not to let too long a period elapse between the moment you are given the signal

to go and the day when you again meet with the executives to present the first fruits of your labors. Although much depends on the type of product, six to eight weeks should be about the average time necessary to organize your material, make a preliminary study, and crystallize your ideas in the form of preliminary visualizations.

When that is done, it is only the beginning. Your final design may be arrived at only after many more months of effort and may resemble your first sketches not at all. But those sketches are control switches by means of which the floodgates are opened, discussion pours forth, and things really begin to happen.

No matter how thoroughly you have studied the problem or how carefully you have noted all instructions, some unforeseen impediment may rise up suddenly, blocking your path like an impenetrable wall. Perhaps the sales manager failed to warn you that, in his best territory, the weights and measures authorities insist that the platter guard of a retail-store scale be $3\frac{1}{2}$ inches high, and your design shows a mere 2 inches. Your gasoline-pump sketches have evoked hosannas of praise until, just before the meeting adjourns, the vice-president suddenly dashes all your hopes by recalling that in California the underwriters insist that electric-light bulbs must be placed 4 feet or more above ground and you have provided for only 3 feet 8 inches. Those 4 inches may mean complete redesign. Such information should have been provided, of course, while you were gathering the preliminary data. But businessmen—and designers—are fallible and sometimes make errors of omission.

Obstacles of the most confusing and troublesome nature are commonplaces in industrial design. Often they seem to defeat every effort with monotonous regularity—another argument for making your first presentation somewhat tentative, without too much of an air of finality.

SETTING THE STAGE

The actual procedure of showing your sketches, of selling your ideas to the client, needs careful analysis and discussion. You have brought to the meeting, let us say, two hard pastel renderings in color. It goes without saying, of course, that they

have a professional touch. They are carefully drawn, neatly matted, immaculately clean.

In addition to these, you have brought your file of rough sketches, a complete set of the client's prints (this is important, for it may delay the meeting to assemble another set), and a pad of layout paper of sufficient size to cover the color sketches in case you wish to make quick suggestions or changes during the meeting.

You may not have occasion to show the file of "roughs" at all, but it is usually well to have them ready. The average businessman has no conception of the hundreds of drawings, the weeks of toil, necessary before even a pastel rendering can be prepared. Like as not he thinks the sketch you show him has been set down with a sure hand after a blinding flash of inspiration, and he may wonder why you have taken six weeks to produce two pictures. We have found that casually thumbing through half a hundred rough sketches may have a salutary effect on the doubting-Thomas kind of client. He may have a greater respect for the job if given a peek at the mass of preliminary material in your files.

In addition to the two main exhibits, you may have made mechanical drawings of certain details to explain features not apparent in the color drawings. These need not be dimensioned and may be in the form of tracings rather than blueprints; but if you bring tracings be sure that prints made from them have been left in your office as insurance against loss.

As stage manager, do your best to see that your drawings get every break. You can command no footlights or "baby spots" (although the latter can actually be used to good effect in presenting models) but at least you can see to it that the light from windows or overhead fixtures strikes your drawings at the right angle. It is almost imperative to have with you a small folding easel, made of wood or wire, or to equip the backing boards of your matted drawings with a triangular flap which will make them stand up on a table or desk. Few offices are properly equipped to make presentations and the business of fumbling with books or of placing drawings against a wall where they slide, or on the floor where they cannot be seen, only bungles the show. You should have freedom to sit and discuss them with your client as an equal, not as a flunkey.

SMALL GROUPS IF POSSIBLE

The personnel of your first meeting will probably consist of the president or vice-president, the sales manager (who may also be an officer), the chief engineer, the production chief, and perhaps the advertising manager. Such a group would be fairly typical. Try by tactful suggestion to keep these gatherings as small as possible, although such decisions are not always within your control. Too many critics spoil the broth. In large groups it is difficult if not impossible to prevent the discussion from trailing off into irrelevancies and eventually bogging down in a hopeless morass of detail which gets you precisely nowhere. If there are any major objections to your presentation, one or two men can point them out just as well as a dozen.

In one mammoth company, the largest in its field, every stage of our work, from rough sketch to finished model, was scrutinized and wrangled over by ten or twelve high-powered executives from the president to second assistant department heads. A secretary sat by taking minutes and the meetings dragged on from early morning through lunch to after closing time, with weary monotony.

Since the project involved a tool and die outlay of better than \$1,000,000, design was naturally a matter of considerable importance to the company. At intervals some member of the group would be summoned away from the meeting, usually just at the moment when the discussion was coming to a point of particular interest to his department. When he got back, everything had to be repeated for his benefit, or else he missed it completely. In the latter case he would raise a great clamor over that particular point at the next meeting, feeling that his toes had been stepped on because he hadn't been advised of such and such a decision. The result was a great deal of delay and confusion, a staggering outlay of executive time, and a result no better than if two or three men had made the decisions and relayed the information in the form of memoranda to the others for written criticism and suggestions.

Presentation meetings afford curious, and often amusing, studies in human nature, replete as they are with clashes of personalities, petty jealousies, undercurrents of company politics,

and humorous interludes. They are a good test of your insight into character, your diplomacy, your ability to sell yourself and your wares. Tact is important, especially with a new client when you are feeling your way about, but tact can be carried to the point where it borders perilously on indecision. Some men hate to be "yessed." There are times when you have to assert yourself, saying, "This should be thus and so, because the principles of good design demand it." After all, your client has engaged you because you are supposed to know.

Frequently the president and the sales manager will know little or nothing about the engineering problems involved in their own products, while the chief engineer may be a total loss in matters relating to sales. Remember that each of these gentlemen looks at your drawings through utterly different eyes, the sales-minded executives thinking "Has it eye-appeal for the customer?", and the engineers questioning, "How shall we make it?" They may disagree violently. There may be a lively brawl, but open disagreement is better than tacit antagonism, for it brings the trouble out in the open.

There is simply no way of predicting the reception your work will receive. The more radical it is the more chance there is that it will be met by stony silence. Instant and openly expressed enthusiasm may, by the end of the meeting, turn to indifference. It is well to distrust too quick acceptance because it is a sign of superficial pleasure in "something different." Then some men are so constituted that they cannot give praise at all, although secretly they may approve. The cautious, the deliberate, even the "dead pan" client, may become your most ardent fan.

Humor is a great leveler, and, if you have the ability to make people laugh, there is much in your favor. Even accidental humor may help. We were designing a certain type of cabinet with all four sides glazed. I was enthusiastic about the then new tempered glass which will withstand even blows of a hammer and I was anxious to demonstrate its properties. On the way to the client's plant, I stopped at the glass company's sales office to pick up some samples in color. When the meeting was well under way, I triumphantly produced a 10-inch square of the new glass, and tossed it carelessly on the floor. It should have bounced; instead

it flew into a thousand splinters. The glass men had given me ordinary plate! But the meeting was a hilarious success.

THE STAGE IS YOURS

Let us assume that your group is assembled and the chairman has given you the floor. The spotlight is focused on you. Remember, these men have no notion of what they are going to see. It may shock them, it may delight them, it may leave them absolutely cold. At least it always has the charm of the unexpected.

You are doubtless as anxious as they to know the reaction. But don't hurry. Be as deliberate as you can without overplaying suspense. If you have any explanations of a general nature to make, and you probably have, make them before you show exhibit A.

Your preamble might run something like this: "Gentlemen, as most of you know, Mr. Robertson has engaged us to see what we could do to improve the appearance of your electric griddle. It is the first job of this kind we have tackled, although we have designed many other items in the appliance field. Your engineer, Mr. Simpson, has been entirely cooperative. He has gone over some of the problems with us to the point where we believe our designs are practical and can be made within reasonable cost limits. However, even Mr. Simpson has not seen the latest sketches we have made.

"Before we show them to you you may be interested to know just how we work with our clients. We usually divide the procedure into three distinct stages: perspective visualizations, models, and finished mechanical drawings. Our mechanical drawings, you understand, are for appearance only; we are not engineers and naturally we cannot expect to know in a few weeks as much about your business as you do. They will be carefully dimensioned, however, and they are intended to convey to your own drafting department the final appearance of the griddle.

"The sketches we are showing you today represent only the first attempts to create a new piece of merchandise for you. It is the first stage. They are subject to change, and, I am sure, improvement. They are being presented chiefly to stimulate discussion. When we leave this meeting and have combed these drawings over for a few hours, we should know twice as much

as when we came, and should be able to proceed much more surely and effectively. So please be frank. We are looking for help and information. We won't resent criticism, but we do believe that we have contributed something new—in fact, well ahead of the parade.”

Some such preface, not too long-winded, may break the ice and help settle your audience in their chairs. Let me suggest that at this stage of the presentation and throughout the rest of the meeting a certain modesty is never amiss. Avoid patronizing your clients and don't be cocksure. If credit is due their own engineering department for certain features of the sketches you are presenting, be sure to give it. The more you can create the impression that you are there to cooperate, not to sell a bill of goods, the happier your relations with that client will be.

NEVER APOLOGIZE

However, once your drawings are on the easel or your models unveiled, let them speak for themselves. If you hover over them like a hen with a brood of chicks, you distract the attention of your audience. Let them ask questions first. Then you can make all the explanations you want.

And *don't apologize!* If you have anything to be apologetic about, you ought not to be there at all.

Avoid the tricky and the cheap. A dignified approach will give the businessman confidence in your seriousness of purpose and your fundamental ability to cope with the problems of manufacture and sales. The modern designer is just as much a specialist as the engineer and he should be just as serious. At the risk of being accused of stealing Dale Carnegie's thunder, let me urge the reader to observe the decent amenities of good business practice: courtesy, brevity, sincerity, and good common sense. None is incompatible with artistic ability, but be ready, if you have departed from accepted practice or tradition, to justify your recommendations with intelligible argument.

XXI · Mechanical Drawings and Design Patents

NEVER CONSIDER a design project complete until you have submitted a complete set of dimensioned prints. It is the final stage. Even if you have made an accurate scale model and your client a full-size model, you should always make mechanical drawings. The blueprint, as Thomas E. French says, is "the most effective and economical method yet devised by man for conveying a *fixed* idea in graphic form."

Although the necessity for dimensioned drawings may seem self-evident, we sometimes lose sight of the real reasons for their importance. (1) From a single set of tracings any number of prints can be supplied, whereas models are expensive to make and almost equally expensive to duplicate; further, only one person at a time can work from a model. (2) You must specify every dimension to the last thirty-second of an inch because subtleties often make or break the final effect. A small model of a large product, no matter how accurate, is difficult to scale for dimension; it should not be left to another to transpose the contours of your model into dimensioned drawings, and small details will be impossible to scale satisfactorily. (3) Models, especially if made of plaster, are easily damaged. One of the most beautifully finished models we ever built was blown off a workbench in the client's experimental department when a compressor safety valve let go. It was smashed to bits.

Just how detailed your mechanical drawings should be is a question which cannot be answered once and for all. A few designers offer engineering service in connection with design. They must therefore be prepared to make complete working drawings. Most established designers, however, do not claim to be

engineers, for they realize that their clients' own engineering staffs are better informed about the facilities of the factory and the customary practices in their particular industry than any outsider can possibly be.

The majority of design organizations provide mechanical drawings simply to convey to the client, in a language generally understood, exactly what they want the finished product to look like. These are not shop drawings, but *guides to the client in making shop drawings*.

Every appearance problem, however, is also an engineering and production problem. Gauge of sheet metal must eventually be specified, methods of fabrication determined. Castings must be designed for practical foundry production and the necessary thickness of sections and reinforcing ribs worked out. These are properly matters for engineer and designer to work out together, strengthening the assertion that appearance and function should go hand in hand from the outset.

You do not prepare final drawings, of course, until you know that the forms and shapes indicated are practical and can be produced within the established cost range. In the course of any major development you will make many tentative mechanical drawings for study purposes or for obtaining preliminary cost estimates. The latter should be clearly marked "For estimate only" or "Preliminary study for"

Of the three chief stages in product design development (rough visualization and clay studies; renderings and presentation models; final dimensioned drawings), the last consumes much the smallest part of the time, perhaps only ten per cent of the total, for you have already made tentative layouts in order to construct the presentation model. With these and the model itself before you, preparation of final drawings is more or less a routine matter.

Let us suppose for instance that you have reached the point of making your final drawings for the molded plastic radio discussed in Chap. XVI. The last cut on Plate 2 shows the final rough sketch. Along with these paper studies, you have worked steadily in clay to get the feel of the design in three dimensions, and you have a complete full-size clay model similar to the final sketch. From this you make tentative mechanical layouts, dimen-

sioned, for your model shop. When you have presented the plaster model to the client and it has been discussed with the molders and perhaps modified to meet certain special requirements, you are ready to make final dimensioned drawings.

You now have considerable data before you, including the finished model itself, although a few minor last-minute changes may be needed which can be expressed in the mechanical drawings without the expense of altering the plaster model.

How far should you go now? Briefly, you need show only those lines and dimensions that will express the *exact exterior dimensions of the finished molded piece*.

You need not show sections, unless they are necessary to indicate, for instance, the amount of opening between grille louvers. You need not specify the thickness of section, as this is best left up to the molder and the manufacturer of the material. In molding the thermosetting materials, section thickness in a deep molding should vary a few thousandths, becoming gradually less near the flash line. These matters will be determined by the man who designs the molds. It is usually not even necessary for you to specify the amount of draft necessary on molded parts to permit easy ejection from the cavity. Your drawing, however, should be plainly marked, "No draft shown."

In short, you specify *all dimensions affecting exterior appearance*. The molder, using your prints as a guide, designs steel molds consisting of steam-heated force and cavity which will be mounted in a molding press to produce a finished piece exactly following the contours expressed on your blueprint.

NOT AN EXACT SCIENCE

Every new product goes through a painstaking process of design and redesign, repeated over and over again. Mechanical engineering as applied to product design is not an exact science, rather a matter of trial and error. In every progressive company this process goes on unceasingly even after the product is offered to the public. There is always more than one way to accomplish any given result. The successful engineer is the one who can find the most effective solution consistent with reasonable cost.

The engineer's mechanical drawings are therefore as complete and exact a record of his thinking on matters of mechanics and fabrication as he can provide up to a certain date. Likewise, your dimensioned appearance drawings record and summarize all the research and design work you have gone through up to the point of tools.

Since your job is creative, you will presumably have many new ideas to suggest which are not standard practice in your client's plant: a new kind of support for a refrigerator shelf; a different dial for a radio involving a novel type of station indication; a device for sliding out the roast as the oven door is being opened. Inasmuch as these features may be essential to the design you have conceived, you may have to work them out in rather complete form before submission to the client.

In such cases you should carry them as far as you can. Then, if they prove too difficult for members of your staff, you may have to call in an engineering consultant. Do not suggest these ideas to your client unless you yourself have at least one possible solution for the problem. When your client says, "That is very nice, but how would you make it?" you should not have to reply, "I don't know." Your client's engineers may find a better or cheaper way, but you should justify yourself with a real attempt to solve the problem first. Minor "inventions" are commonplace in most industrial design offices, because the attainment of different appearance often involves new mechanical devices.

FOLLOW STANDARD PRACTICE

Nothing will make the engineer more suspicious of your competence than badly planned, careless, or inaccurate blueprints. It is almost more important for you to make good mechanical drawings than for the client himself. Be sure that your mechanical drawings *follow standard drafting practice*. Industrial designers are often recruited from other professions, such as architecture, where a different style of drafting is used. It is a different language, or perhaps a different dialect of the same language. The engineer or the man in the shop may be able to decipher it, but he will be annoyed and with good reason. Excellent textbooks on drafting are available and every design office should be supplied with a recent edition of a standard work on the subject.

Each mechanical drawing that leaves your premises should be subjected to the closest scrutiny. It should be gone over by a competent checker, the latter taking equal or in many instances more responsibility than the draftsman. Nowadays it is considered the best practice for the draftsman and checker to *sign his name in writing*, rather than letter it.

Tissue pad sheets, as described in Chap. XV, furnish an adequate and inexpensive material for making preliminary mechanical layouts. They are usually not available in plant drafting rooms. Final tracings, however, should be made on a tough vellum that will stand erasure and produce clear prints.

Printed tracing sheets can be ordered through any material supply house in sizes adapted to your type of work and the kind of filing cabinets you use. It will be found convenient to have two sizes identical with your layout sheets, that is, 11 by 17 inches and 17 by 22 inches, so that they fold easily for standard envelope sizes. Still larger sheets can be made up in multiples or cut from rolls as required. Tracing sheets should be printed with a border and places for name and address of firm, description of drawing, names of draftsman and checker, corrections, etc.

A PERMANENT RECORD

Your tracings form an important record of completed work and should be carefully preserved in proper filing cabinets. Months after a job has been completed you may be asked to provide additional prints. Remember that once the work is paid for, the tracings are the property of the client; you should be able to provide prints without delay. Methods of filing and indexing prints are given in Chap. XXV.

Do not send tracings to the client unless, when the job is completed, he asks for them in writing. If lost in transit, you will simply have to make them again. An exception to this rule might be made in the case of drawings which involve difficult freehand curves or sweeps. If the client plans to make a dummy model, let us say, you should make a duplicate tracing of these curves to be used by the pattern shop in prick-punching them onto the surface of wood, because blueprint paper shrinks and the contour would be unreliable. There is usually no need to make a duplicate tracing of the entire drawing, merely the curves you wish the

patternmaker to interpret accurately. A print from the original tracing, if accurately dimensioned, will supply all the necessary information for regular geometric forms,

SPECIFY LIMITS

In concluding any agreement or contract, have a clear understanding with your client about the kind of mechanical drawings you will provide. Whether you use a contract form or merely a letter of agreement, it should state that you will provide "complete dimensioned drawings on all factors relating to appearance." It is well to add that you "accept no responsibility for gauge of sheet metal, thickness of sections, specification of materials, or any other elements of a mechanical, structural, or engineering nature."

The border line between your responsibility and your client's is sometimes rather hard to define. If you have made mistakes on your drawings and the client, in making shop drawings from them, perpetuates the error, the responsibility really goes back to you—all the more reason why you should see to it that your dimensioned drawings are correct.

Since the exterior design of a product and its mechanical operation are in most instances closely interlocked, it is well to have a disclaimer printed on your tracing sheet forms, so that it will appear on all blueprints. It might be worded as follows: "NOTE: This drawing is submitted as an appearance design project only. The designers accept no responsibility for production practicability. If further information is required, consultation with the designers should be requested."

DESIGN PATENTS

The laws relating to design patents are comparatively simple. The United States Code provides protection if your design is new, original, and ornamental. This type of patent is not particularly expensive; preparation of the papers is a routine matter. Only one claim is allowed and the burden is thrown on the patent drawings, usually made in perspective if the subject is three-dimensional.

Design patents may be obtained for periods of $3\frac{1}{2}$, 7, or 14 years. They issue much more rapidly than mechanical patents.

This is not the place to discuss the details of design patent law, for that has been done by others more competent than I (see Appendix B). A few matters, however, should be called to your attention because they have a direct bearing on the conduct of any design business.

First and foremost, establish connection with a competent patent attorney and discuss all of your problems with him. He will give you valuable advice and save you much time and worry. If you are developing an idea on your own, he will have a patent search made and secure already issued patents that may be similar to your idea. He may find interference. Therefore discuss your ideas in sketch form with him before you have wasted a lot of time developing them in great detail. In any industrial design studio ideas constantly crop up which the designer believes to be quite new. A search may prove that an almost identical product has already been patented, although the interfering patent may never have reached the stage of manufacture and sale.

When you sign an agreement with a client, no matter what the basis of remuneration is, you should have it clearly understood that you will assign to him all design patents (or mechanical patents as the case may be) which relate to the scheme finally accepted for production. But patent expense should be borne by your client.

In a survey on package design fees made by the Institute of Package Research one designer said: "Where I am working on a prearranged fee basis, I obtain a written order containing an agreement to pay so much for a specified service. When it happens that I discover or devise, in the preliminary studies, a feature or method not specified in this agreement which may tend to benefit the product by, for example, reducing assembly costs, I have my idea notarized and then apply for protection or a patent before submitting it to the client."*

This may be accepted procedure in package design, but in industrial work, where you accept a contract to improve the product in every way possible affecting appearance and convenience, an improvement in assembly procedure might be merely a by-product of improved styling. Likewise, a new mechanical device, even a patentable one invented by yourself,

* *Modern Packaging*, November, 1938.

might be necessary in order to obtain added convenience. You therefore accept your contract on the basis that everything you do for the client directly relating to the finished production article becomes his property. You should not hold back ideas. Submit everything and make proper assignment to the client when the time comes.

If, when your contract is satisfactorily completed, you wish to submit one of the discarded designs to another manufacturer, you should obtain a written release from your client. He may, however, decide to use it as an additional model, or a model for the next season. In that case he should give you additional compensation for the further development work necessary to bring it to the point of tools.

To sum up, your attitude should be this: for the duration of the contract, you and your associates are employees of the client. As such, your best thinking and your best work belong to him.

SAFEGUARDING YOUR CLIENT

There are many ways in which you can protect your client's interests. I have emphasized in other chapters the importance of signing, dating, and filing all rough visualizations and mechanical drawings. They form a running commentary on the development of the design project and they must be carefully preserved. Together with other data such as time cards and work sheets, they form an invaluable record in the event of patent litigation.

If you have developed some particular feature which you believe to be patentable, make sketches explaining the idea or device clearly, sign and date them, and explain them carefully to at least two other people. You should then inscribe on each sheet something like the following: "These drawings have been explained to me and I understand them fully." Under this, each witness should affix his signature in ink.

Notarizing the sketches is one way to establish the date of a patentable idea effectively. Another sure way is to prepare the drawings or sketches in the above manner, then post originals or photostats, sealed with wax, to yourself by registered mail, preserving the envelope with its unbroken seal and the registry receipt. Such evidence would be incontrovertible in any court of law.

The increasing parade of design patents through the Patent Office since industrial design became a specialized profession has been phenomenal. For years design patents had been common in dress goods, textiles, silverware, jewelry, watches, toys, and novelties. But in the particular realms of manufacture dealt with in this book, they were almost unheard of until the late 1920's. Refrigerators, tractors, typewriters, soda fountains, lubricating equipment, furnaces, and like products were not covered by design protection for the simple reason that they were not good looking enough to need protection.

Today, with manufacturers paying sizable fees for professional design counsel, as well as huge sums for tools and dies to produce the designs, it is not surprising that they should seek all the protection the law provides and the courts allow, to protect their design investment.

XXII · Identification and Data Plates

NEARLY EVERY product or machine bears some kind of identifying mark or name plate. In addition, patent numbers, style letters, instructions for operation, and much other data may be called for, some of it required by law.

Some of these markings must be made visible, others may be partially concealed or entirely hidden. All markings visible to the eye when the product is on display or in use become an important part of the design and you must give them thoughtful attention from the beginning. If left to the last they may become orphans whose plight you may deplore, but whose situation you are powerless to ameliorate.

It is important to the manufacturer to have his product quickly and easily identified. The design theme itself sometimes provides sufficient identification. One automobile company has retained an identifying theme throughout its entire history, merely modernizing lines to keep up with the general style trend; but in the rest of the automotive industry, and in many other fields, styles change completely every year or two. Therefore, labeling is a necessity.

It is equally important to treat identification marks and other data in such a way that they will fulfill the function the manufacturer expects from them and yet be an integral and beautiful part of the entire design. It may be going too far to say that a data plate can be made a work of art, but at least it can be clear, legible, and so well planned that, instead of being a necessary evil, it becomes an attractive accessory.

The material treated in this chapter may be divided into three general classes:

1. *Identification marks*: including trade names, style names, trade-marks, and devices in various combinations.

2. *Data plates*: including patent and inspection data, maker's name and address, instructions for operation, warning notices, underwriter approval, etc.

3. *Operating accessories*: including dials, timing devices, switch plates, thermal indicators, control panels, etc.

Identification marks are employed in all groups of items susceptible of design: consumer products, commercial equipment, and capital goods. Data plates, of the visible sort at least, are not often required on consumer products unless safety demands it (furnaces and water heaters), but are the general rule in other fields. Operating accessories sometimes become an integral part of consumer appliances (ranges, air conditioners, radios, home laundry units); they are more frequently met with in commercial equipment; and they are of prime importance in capital goods.

1. IDENTIFICATION MARKS

For the sake of brevity I shall refer to all marks in this class as name plates whether they are trade-marks, trade names, model names, or the company name by which the product is generally known.

The name plate is a problem within a problem. I have repeatedly emphasized that industrial design is a three-dimensional art, but in the vast majority of cases the name plate, whether made of metal, plastic, or paper, is a two-dimensional spot attached to a three-dimensional form.

If expertly handled the name plate may be made the focal point of the entire design or, if identification should be "played down" due to the particular type of product, it may be made inconspicuous yet still visible.

The prominence given to the name plate varies to some extent with the type of product. In consumer merchandise it must not be made too insistent. It is a tactical error to convert the product into a signboard; the consumer resents it. In fact certain types of appliances used on the table or in the living quarters of the home—toasters, griddles, waffle irons, percolators, radiators, bathtubs,

and architectural hardware, those products which may be said to become part of the general scheme of decoration, should bear no visible identification at all. Such items are usually marked underneath, inside, or not at all.

Most retail-store equipment is clearly—sometimes too clearly—marked. You can hardly blame the merchant if he evinces more interest in advertising his own shop or the brands that he sells than in showing the name of the company that builds equipment to keep meats cool or dispense soft drinks. As with consumer merchandise, a certain gentlemanly reticence on the part of the maker will be appreciated.

Capital goods, on the contrary, may be labeled boldly and without restraint, but it is even better if you can evolve a theme of treatment that will identify your client's machinery without resorting to overprominent labeling (see Chap. XXVII and Plate 18).

Name-plate shapes should be chosen with two points in mind: (1) fitness to the material (lettering, trade-mark, or device) which the outline encloses; (2) fitness of the name-plate outline to the entire product. Sometimes it is no simple matter to reconcile the two. The product may have a long name, "Challenger" for instance, and yet the ideal shape to harmonize with the product might be a circle. Or perhaps your client has an established trade-mark in some tall vertical form, whereas the product positively demands a plate in the shape of an elongated rectangle or ellipse. Such apparently simple problems often consume a surprising proportion of the time devoted to the entire job—a fact which the client can seldom be made to comprehend.

If the name plate is to become the focal point of your design, the prime rule is to *make it simple*. This applies not only to its outline or "silhouette," but to the material within the outline, whether it be lettering, emblems, or symbolic devices. If lettering predominates, it is only sensible to make it as legible as possible. Other elements should be conventionalized. Play up broad masses; avoid fussy detail.

Color, too, should be simple. Metal plus one color is all that a good designer needs in order to make a striking name plate. Two colors would be about the limit, not only to avoid confusion but to keep down cost.

Basic Shapes

Figure 154 shows some of the basic shapes that might be used for name plates. Any one is good in itself. Observe the analogy between these outlines and the basic design solids pictured in Fig. 26, Chap. IX.

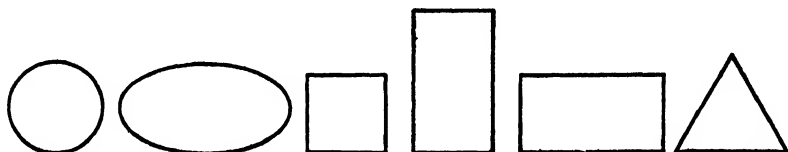


FIG. 154.

Certain modifications of these basic outlines may safely be made. There can be almost any relationship between the major and minor axes of the ellipse. Rectangles may be stretched out until they become bands. The triangle need not be equilateral,

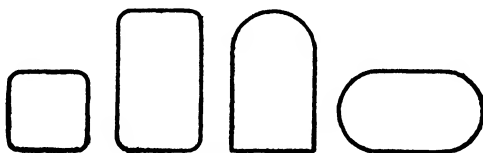


FIG. 155.

and it might be inverted. Corners of the square might be softened and the rectangles also might have rounded corners or terminate, at one or both ends, with a semicircle (Fig. 155).

Avoid making the outlines complicated, however, by combining them injudiciously, or by adding bumps, angles, and

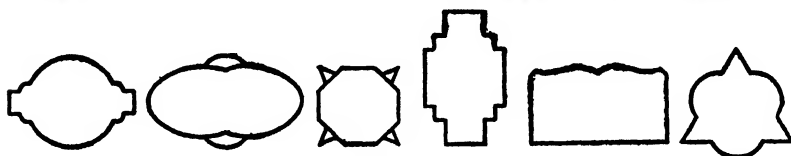


FIG. 156.

what-nots under the mistaken impression that it will make the design more "artistic" (Fig. 156).

To describe and illustrate more than a few of the possible design combinations within each of the basic shapes in Fig. 154

would consume too much space. Perhaps a few imaginary examples of right and wrong will point the way.

Figure 157*a* displays a name plate for a refrigerator. The simplicity of the circle harmonizes with the soft sweeps of the cabinet top and the door. It is done in satin-finish chrome with a

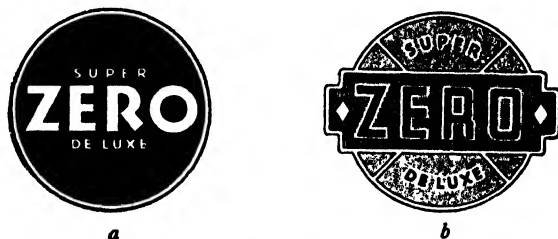


FIG. 157.

light gray-blue enamel background. Three colors are used in *b*: red, blue, and yellow. It is crowded, illegible, inappropriate, and expensive.

Figure 158*a* is a transfer to be attached to the sheet-metal housing of an instantaneous gas water heater. Its curves harmonize well with the cylindrical body. The lettering is distinct, readable even from the curb when displayed in a dealer's window. On the other hand, *b* is crowded and not readily legible. Never,

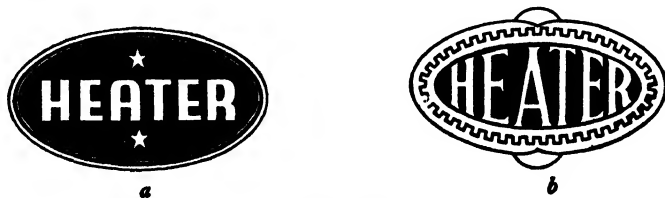


FIG. 158.

under any circumstances, attempt to make a line of lettering follow the top or bottom lines of elliptical forms.

The next pair of sketches represents a name plate for a domestic air-conditioning unit. It is to be placed off-center, toward the upper left-hand corner, on the flat sheet-metal panel forming the front of the unit. The tall letters, finished in bright chrome against a red enamel ground, make a square pattern in themselves, but still they are legible. This company had a logo-

type which the president wanted to use if possible, but it was so ugly in itself that it could not be fitted into any reasonable composition the designer was able to devise, so it was abandoned (Fig. 159*a* and *b*).

Avoid vertical lettering because it goes counter to the reading habits of Occidental peoples. In certain cases, however, where all

*a**b*

FIG. 159.

letters are "center-balanced" (like H, M, O, and V), and the word is short, you might attempt it if the composition seemed to demand a vertical type of plate, as in Fig. 160*a*; *b* is another treatment of the same shape, and, although obviously bad, it is no worse than plates that are being registered

every day and reproduced in every issue of the *Patent Gazette*.

Long-established concerns are often saddled with ugly trademarks and logotypes which the management feels have become so intimately associated with the product that they cannot be abandoned. There is a classic battle going on all the time between the manufacturer who is loath to change them and the designer who has to make the best of them.

In most cases there is no good reason for him not to change. Better lettering style and greater legibility would more than offset the "identification value" the manufacturer so fondly believes he has established.

If it is impossible to persuade him to give them up, you can

sometimes modify them enough so that they are more attractive without entirely losing identity. Either that, or "play them down" to the point where they cease to be so objectionable. I recall one instance of an elaborate and highly colored coat of arms which had become almost part of the product. Unable to induce the client to dispense with it entirely, the designer was finally allowed to reduce it in size, then enlarge and modernize the "logo"

*a**b*

FIG. 160.

enough so that it dominated the entire plate and made an attractive design.

Derivative Shapes

Suns, plant forms, hearts, stars, diamonds, and other nature-derived shapes should be used as outlines for name plates only with great discretion. Sometimes these shapes become so closely associated with a product that, regardless of design difficulties, they must be kept at all costs. A sea shell well designed is the device of a great oil company, and the obvious association of stars with products using that shape as a brand name is well known.

There are two derivative outlines that deserve special mention because they are so common today: wings and the streamlined form.

Because of their irregular outline, wings are expensive to make by some processes and equally difficult to design well. If you have to use them, try to conventionalize the shape so that they suggest the actual form rather than depicting it.

The streamlined shape came into popularity along with the widespread misuse of the word itself. It is the old familiar air foil, sometimes long and thin, sometimes short and bulbous. Obviously this type of name plate has no place on a chunky, squat object, although it can be found almost any day embellishing battery cases, furnaces, toilets, radios, and sundry objects where its appropriateness is dubious to say the least. There is some reason for employing this shape on bicycles, outboard motors, scooters, and grown-up transportation units, although it is difficult to inscribe good lettering within the outline. The Lincoln Zephyr plate is one of the best, and another good example will be shown later.

I do not mean to rule out all derivative forms, but to emphasize the fact that simplicity usually does the best job of selling; and the object of product design is sales.

Lettering

Lettering is a specialized and exacting art in itself. It is said that good lettering men are born, not made. You should know the basic letter styles, but it cannot be expected that you will

always strike the ultimate note. You must be smart enough, however, to know your limitations and, when necessary, to engage an expert to solve this particular part of your problem.

Script lettering is especially difficult; it must be handled with great adroitness, for bad script is worse than no identification at all. Script can be made to amble or to race. It can express

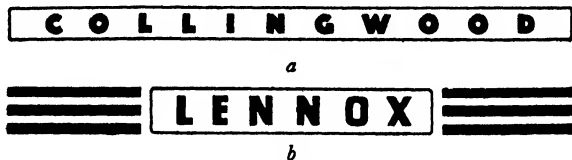


FIG. 161.

playfulness, quality, or dignity. The type of product will dictate the style of script you will use. Above all, avoid the common error of underlining a script word with a swirl from the tail of a *Y* or a *G*, an old-fashioned trick straight from your grandfather's Spencerian sample book.

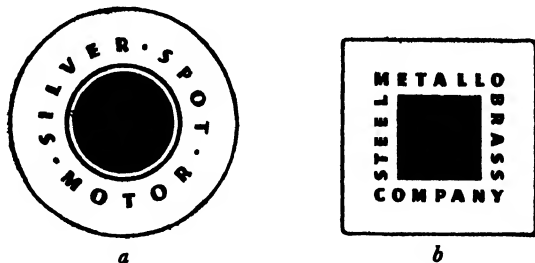


FIG. 162.

If you want identification to be less conspicuous and yet visible, there are various devices to which you might turn. Lettering can be coined or embossed into a molding, as shown in Fig. 161*a*. Or a separate plate in the form of a narrow band can be placed in such manner as to look as if it were an extension of, and continuous with, painted or stenciled stripes, *b*.

"Letter spacing," or increasing normal spaces between letters, is a device used in typography for decorative effect. It has a tendency to reduce emphasis and if carried to extremes, makes legibility difficult. When spaces between letters are increased to a point beyond easy legibility, each letter then

becomes a small design element, or **spot**, in itself. This provides a clue if you want to reduce immediate identification to the minimum, yet have the legend actually present so that it can be read if searched for, as in Fig. 162*a*. and *b*.

Name Plate and Product

So much, then, for the fitness of the outline of the name plate to the lettering and other material it encloses. What about the fitness of the entire name plate to the product itself?

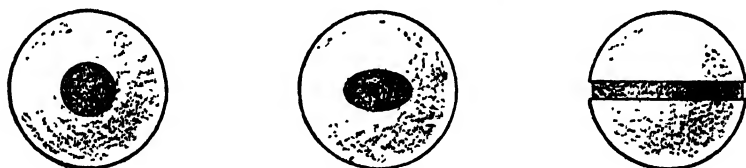


FIG. 163.

Let us refer for a moment to the basic three-dimensional forms discussed in Chap. IX. They were: sphere, ellipsoid, cube (and related shapes), cylinder, pyramid, and cone. We can readily eliminate the ellipsoid, the pyramid, and the cone, for few modern products are basically cast in these forms. We are left with spheres, cubical and rectangular shapes, and cylinders.



FIG. 164.

Complete spheres, too, are rare, except as parts of other forms, although I know of a certain piece of service station equipment made of two hemispherical stampings lock-seamed together and provided with a spreading disc-shaped foot. There are only three name-plate forms satisfactory for this shape: a circle, a long ellipse, and an encircling band (see Fig. 163). Rectangles or squares will not do. The sphere seems to require the harmony of other curvilinear shapes, either circles or ellipses.

The infinite variety of square and rectangular surfaces in modern design makes illustration difficult without using hun-

dreds of examples. A few combinations will therefore have to serve. Figure 164 shows four squares; *a* and *b* are not good, but *c* and *d* would be perfectly permissible.

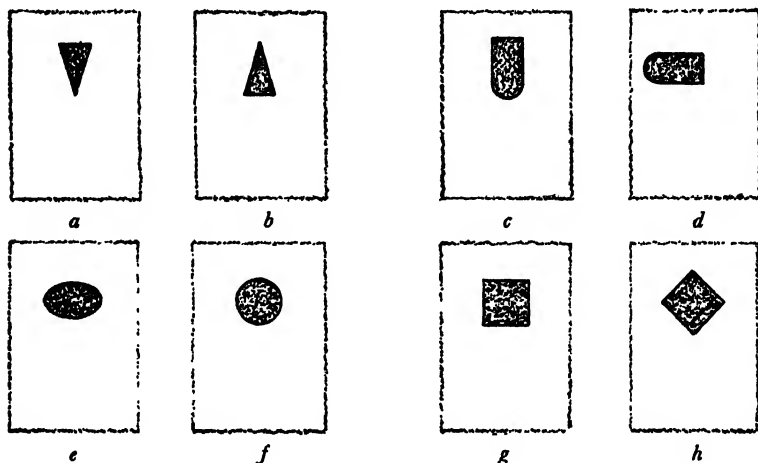


FIG. 165.

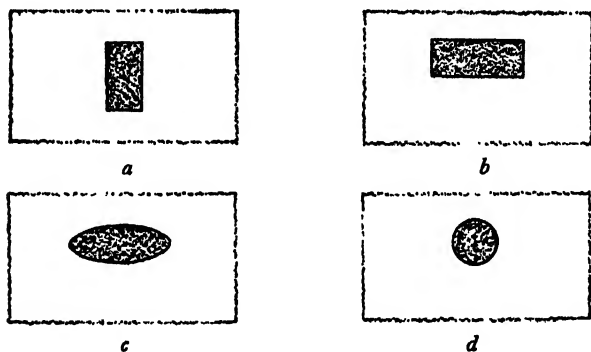


FIG. 166.

Several rectangles are displayed in Fig. 165, possibly the front of a sheet-metal furnace housing. The first two, *a* and *b*, have triangular name plates at proper reading height; *a* is correct, *b* is incorrect. The next pair, *c* and *d*, show good and bad uses of a rectangular plate with a rounded end. *e* is a rather inharmonious use of the ellipse, but with a circle, *f*, it is hard to go far wrong. A square plate, too, as in *g*, would be permissible,

but if we turn it 45° , making a kind of diamond as in *h*, it appears a bit "restless."

If the main rectangle were horizontal, you would certainly not use a vertical rectangle smack in the center, as in Fig. 166*a*, but rather "recall" the horizontal form in your choice of name plate, *b*, and place it well above center. Here is a case where a long ellipse, properly used, as in *c*, would be satisfactory, but a circle, *d*, would be quite lost, having no relationship whatever to the principal form.

The cylinder remains. Figure 167 shows several possible name-plate treatments on a cylindrical shape: the circle, the

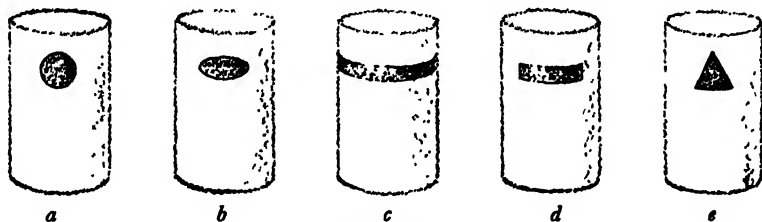


FIG. 167.

ellipse, and the encircling band, *a*, *b*, and *c*. The remaining sketches, *d* and *e*, show combinations not to use: a long rectangle and a triangle.

The habit of crowding name plates with a dozen other odds and ends of information is happily on the way out. The name plate should provide identification and should be properly related to the form—nothing more. Manufacturers are beginning to realize that they cannot tell their whole story in one place and still have it legible. Now, as a rule, factual data is relegated to a separate plate or transfer, and placed where it offers no competition to the name plate proper.

2. DATA PLATES

If the place for patent, serial, and model numbers, instructions, service data, underwriters' approval, etc., is not on the name plate, then where will you put them? On a separate plate, wherever possible, located so that it will not be too conspicuous. But you cannot always conceal this material entirely from the eye. Certain information must be visible at all times. Pumps

dispensing gasoline which contains tetraethyl lead must be so labeled as to warn the customer that the liquid contains a poison and should not be used for cleaning purposes. In the designs of furnaces and water heaters, certain instructions and warnings must be prominently displayed. Occasionally the law even specifies the size and style of type to be used.

These are problems you will frequently meet. To repeat the warning in Chap. XIV, do not wait until the last moment to obtain the necessary information, but get it at the outset. If you don't, your carefully conceived scheme may be ruined.

Whether the data plate is prominently exposed, or placed at the back where it will not be seen so often, it is part of your job to see that, if visible at all, it is designed as attractively and artistically as possible. Remember that you are responsible for every detail that can possibly meet the eye. In commercial and capital goods, blank spaces for future patent numbers provide a tough problem in themselves. Let us suppose that you are using an etched plate with bright metal letters on a dark ground. The numbers of patents already issued will be etched into the plate like the rest of the lettering, but your client has several improvement patents pending and he does not know just when they will issue. He therefore orders a quantity of data plates bearing several long rectangular blanks, and, when the new patent numbers are known, he has them die-struck into these blank spaces. Similarly, the name of the inspector may be machine-engraved or die-struck in another blank space.

These blanks are difficult to arrange properly because their visual weight is so much greater than the weight of the lettering itself. You must try to manipulate them so that at least they make a definite pattern. It would be useless to multiply illustrations, for every problem is different and the number of possible combinations is endless.

One illustration will have to suffice. Baker Perkins, Inc., manufacturers of bakery machinery, used to use a large name plate which did duty as identification and data plate combined. It disclosed a trade mark, the company name, two slogans, the company address, and all patent and inspection data. The lettering was old fashioned and the material was so arranged that it was difficult to read.

In redesigning their equipment, we created a monogram in a circle to provide quick identification, then broke the single plaque into two separate plates. Since the company name identifies all of their machinery and the address is short, both were used



FIG. 168.

on the name plate, as in Fig. 168. All other data were placed on a separate plate (Fig. 169). Both are being produced in several sizes.

3. OPERATING ACCESSORIES

This classification is a large one. It includes dials, gauges, switch plates, thermal indicators, control panels, timing devices, and many other items. Each one is a problem in itself and the principles governing their design are similar to those affecting name plates; that is, the material contained within the device must be harmonious with its own outline, and the outline of the device must harmonize with the product or machine on which it is mounted.

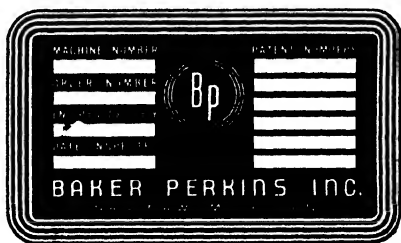


FIG. 169.

Consumer products such as the modern electric range frequently include many such elements in a single area, the back rail. It may look almost like the dashboard of an automobile, including a number of switch knobs, a thermometer, "jewel" telltales, oven vents, a timer, a clock, and a lamp. The proper design of each component and the harmonious relationships between them will consume much of the time spent in designing the entire range.

As an example of dignified treatment of several operating accessories, we shall choose a control panel for a commercial dough mixer, also made by Baker Perkins. Here the buttons for starting, stopping, reversing, etc., have been arranged in a vertical panel carrying out the theme established for the entire line of machinery. Spanning this plate is a U-shaped handle (not shown

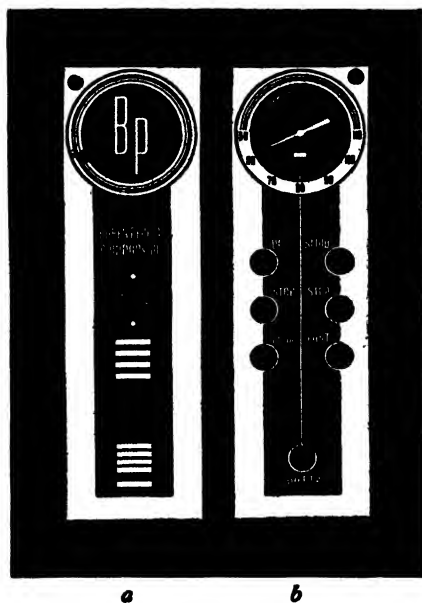


FIG. 170.

in the drawing) and buttons are so placed that, because of the height of the handle, the operator has to use both hands to start the machine or close the door. The temperature indicator, in the form of a dial, surmounts the entire design (Fig. 170*b*); *a* shows a balancing data-and-name plate mounted on the opposite side.

In some instances one plate must take care of everything: identification, data, and controls. It will then be your job to combine them as ingeniously and as artistically as you can. Figure 171 is a good example of design ingenuity in coordinating disparate material and giving it style and character. This plate also illustrates a difficult shape to treat successfully: the streamline form.

TYPES OF PLATES

Scores of different materials are used in making identification and data plates. To choose the proper material you must take many factors into consideration: (1) the product, (2) cleanability, (3) weather conditions, (4) quantity, and (5) cost.

If the product is expensive, it deserves a handsome identification spot. If frequently cleaned with a cloth, avoid plates with burrs or catchy edges; any product washed daily cannot have a paper name plate or one made of a metal that will rust. If the product is installed out of doors, weathering qualities and fastness of colors must be considered. Quantities ordered and the number of colors you can use often dictate your choice. Last but not least, comparative costs must be carefully weighed. Small transfers and metal-foil plates may be had for a fraction of a cent, whereas coined plates filled with jeweler's enamel or plates made of transparent plastics may run into real money.

Let us list the principal types of name plates, with brief comments on each. Familiarity with materials will come only with long experience.

Transfers: Also called decalcomanias, or just "decals." Many varieties of color combinations are possible. Avoid designing transfers that require half-tone screens; metal inks, too, are not particularly successful. Decals cannot be placed on a surface curved in more than one plane.

Gummed labels: There are many varieties, some made with metal foil. If properly designed, they can be most attractive. Avoid too many colors and keep metal areas well defined. Wearing qualities in certain applications are not good, but they are easy to apply.

Plastics: The field for plastic name plates has only begun to be exploited. The urea plastics, with their brilliant color range and



FIG. 171.

fastness to light, have great possibilities. Lettering may be raised, or depressed and "wiped in" with a contrasting color. The transparent plastics in the acrylic and polystyrene groups, with their possibilities for three-dimensional effects, are being exploited more and more for high-class products where their relatively high cost is not a deterrent.

Metals: Metal plates are produced in many ways: sand-cast (large industrial plates), die-cast, coined, etched from sheet stock, lithographed, etc. Many materials are used: steel, brass, zinc, aluminum, and bronze among them. Prices range from a few cents for a small etched plate to several dollars for a large bronze plaque. Color may be applied in several ways, and there are many ingenious devices for fastening these plates to sheet metal and castings without showing the means of attachment.

Vitreous enamel: Porcelain fused on steel offers possibilities in larger sizes. For outdoor applications, where weather conditions are severe, only bronze is superior. Vitreous enamel plates must be designed with generous radii to avoid chipping. Various colors can be used, and, by means of the silk-screen process or vitreous transfers, intricate and subtle designs may be produced.

Die striking: On certain products, mentioned before, identification must be present but not immediately visible. Some are subject to heat, frequent washing, or abrasion (a cast-aluminum frying pan for instance), and may be die-struck on the bottom with hardened steel dies, thus impressing in the metal the maker's name or trade-mark.

PREPARATION

The design and preparation of identification marks, data plates, and accessories is a laborious and exacting task, seldom appreciated by the client. It must be done, however, and done well, if your design is to possess those last refinements of detail which are so important.

When the full-size model made in your own studio is finished, (or the mock-up built in your client's plant), you should be ready with comprehensives of all plates and accessories and affix them in their proper places. Metal name plates can be simulated by using laminated metal papers, then applying the design in colored inks, in tempera, or by pasting colored papers over the required areas.

Other types of plates may be treated in whatever manner will give the best effect.

After your comprehensives have been approved, you should be through as far as name plates are concerned. You should not be expected to make the finished India ink drawings unless, perchance, your design calls for something so unusual that you dare not leave final execution in another's hands. It is customary, therefore, to turn over the comprehensives themselves (or photo-stats) to the supplier manufacturing the plates, leaving it to his art department to make the finished drawings. You must make it clear, however, that all finished art work is to be submitted to you for final approval. Large name-plate companies maintain artists to do just this work, and, although you may not think much of their creative ability, you will come to respect their craftsmanship.

XXIII · Color Technique

IN AN EARLIER chapter I attempted to condense in too few pages the vast subject of color, suggesting its importance to industrial design and pointing out fields for the student to explore further by himself. But in the daily practice of industrial design, practical matters come up every day which must be treated briefly if this book is to make any claim to comprehensiveness.

Let us, therefore, divide color technique as follows: (1) color in relation to form, (2) color and texture, (3) color and materials, (4) mechanical aids, and (5) color specification.

1. COLOR AND FORM

Perhaps the most important of all is the relationship between color and form. The visual effect of any given color changes to a marked degree depending upon the nature of the form to which it is applied. Let us suppose that we have three geometrical forms made up in wood. We have treated them so that they will take a perfect lacquer finish; we have a spray booth at our disposal and a paint gun, the receptacle of which is filled with bright red lacquer. The shapes we have chosen are a sphere, a cube, and a cylinder of relatively the same volume. We shall give them all identical treatment, spraying them all evenly and drying them all under the same conditions. The color, please observe, is all the same batch—identical in hue, value, and chroma—and the lacquer produces a high gloss.

When they are dry we place them all side by side in a room, lighted by a big north window, against a background of neutral gray. Other objects of brilliant chroma which might be reflected in the glossy surfaces and disturb our experiment have been removed.

Does the variation of form affect the color? At first you might be inclined to say no, because it is obvious, if you look at the half

lights, that the color is pretty much the same. If you are not accustomed to studying color closely, your eye may not observe slight variations.

Now half close your eyes and look again, trying to take in all three objects at once. The cube looks definitely lighter in *value*. Its flat surfaces cannot reflect much light (unless the front face is accidentally placed so that it catches a reflection of the light source over its entire surface), whereas the sphere shows a big high light, reflecting the entire window, and the cylinder shows a vertical high light down its entire length, blending off as the form recedes from the eye and becoming darker and darker as it goes around to the back. With your eyes half closed the sphere and the cylinder appear darker because of the violent contrast of values between the brilliant high lights and the darks. Further, the gloss finish picks up dark objects and the curved forms condense and concentrate them. Thus, contrast makes the darks appear darker than they really are.

The same is true of any freehand form involving soft sweeps—the fender of an automobile, for instance. Paint a fender, rub it, and repaint it; then give it a high polish with wax. Use the same paint from the same batch and spray a piece of flat sheet metal. Place the two in the same light (again seeing to it that the flat sheet is not tilted at an angle which makes it catch the whole light-source reflection), and it will be hard to believe they are both the same color.

How, then, does this apply to designing products? Let us imagine again that you are designing an oil-burning furnace. Your client's sales are booming. He is on the verge of tooling up to make the furnace housing out of big stampings. His former line was made on brakes—all flat surfaces, a few radii on the edges being the only curvilinear forms.

His line has always been identified by a standard color—a medium-dark blue-green. When the tools are built to your design, and the cabinet is assembled with its soft sweeps and subtle changes of contour, he paints it the usual color. But he finds, to his surprise, that it doesn't look like the same color at all, although the paint in the guns was taken from the same drums. It will be up to you to specify a lighter shade of the same hue and chroma, in order that the new streamlined furnaces will *appear* to be the same color as the old.

Size of radii and fillets may have much to do with color selection. The smaller the radius or fillet, the more concentrated the high light. Many manufacturers make the mistake of asking you to specify color after submission of the small-scale presentation model. They do not realize that the color on a small model may not look the same at all on the full-size product, even though matched correctly. Final color specification should never be made until the product has been constructed full size.

So far we have spoken only of one color. Two or more colors complicate the problem, because the relationship of various areas comes into play. You may have decided on a two-color combination of contrasting values, white and a dark green perhaps, or light gray and maroon. You should make many color studies during the rough visualization stage, before you begin to build your presentation model, trying to adjust the correct relationship of areas before the final forms themselves are established. Even then, it is sometimes difficult to establish the proper color separation with any finality. Complete changes of form may be necessary even after full-size models are built.

A recent experience brought this to my attention in dramatic fashion. We had been working for several months on a large piece of commercial equipment. Hundreds of sketches and many renderings had been made, a design finally selected, and a presentation model built. It consisted of a main central form with setback buttresses on either side.

This particular type of equipment is always painted to the specifications of the purchaser. Therefore, before painting our presentation model, we asked the client what color was called for most frequently. Red and black, we were told. So we painted the model red with black buttresses. It was presented, received with acclaim, and, after making minor changes, we prepared dimensioned drawings and the client began building a full-size wooden dummy.

So far so good. A week later we got a long-distance call, "The new model looks like a monstrosity! We thought the pattern shop had got the dimensions wrong, but we've checked them carefully and they are exactly the same as the small model. Come down at once." When we arrived at the plant we found that the big model had been painted *all red* instead of red with

black buttresses. There was no doubt about it, it looked much too wide.

We rushed it to the paint shop and changed the scheme to red and black; placed side by side with the small model, little difference could be detected. Unfortunately, however, we found that one of the best customers always specified solid red. In the end we rebuilt the model entirely. An *illusion* of slimness had been created by the "disappearing" black buttresses.

2. COLOR AND TEXTURE

In our previous experiment with the sphere, cube, and cylinder, we painted our forms with a high gloss lacquer, the shiniest surface we could obtain. Now, using the same forms for demonstration, let us see what effect texture will have on color. We have the pattern shop build another set of forms exactly like the first group. Then we instruct them to cut flattened V-shape serrations into all six faces of the cube, make small concave depressions in the sphere, and cut flutes in the cylinder. We spray them again with glossy lacquer.

Now we set them up, side by side with the others. By breaking up the surfaces and increasing the number of high lights, we find that the color has become appreciably *lighter* in value, judged cube against cube and sphere against sphere. What we have done is merely to introduce so many small points of light that we have given the *illusion* of a lighter value, although the actual color remains the same. Again form is seen to have its effect on color.

By extension, you will find that this principle has a great deal to do with industrial finishes. Paints and lacquers are obtainable in all varieties of reflectivity, from high gloss to matt. Many of the special finishes, pebbled, suède, wrinkled, crystalline, etc., which are obtained by introducing various chemicals into the paint, have a profound effect on the apparent shade. Spray a sheet-metal surface with a dark blue, for instance; then, using the identical pigments, alter this to a finish which, when dry, breaks up into minute planes, each of which catches tiny reflections of light, and you will discover that the blue has changed to a medium shade.

Finish textures are often dictated by practical needs. You might want your smartly styled unit heater to have a high gloss

cast phenolics, acetates, etc., produce excellent imitations of tortoise shell, marble, and many other materials. Again, do not let these imitative effects lead you too far from the straight and narrow path. The materials themselves are attractive enough.

d. Vitreous enamel: Vitreous enamel, also called porcelain enamel, is glass fused to the surface of metal at high temperatures. A wide range of colors may be obtained by the introduction of inorganic pigments. Due to the unstable nature of some pigments such as the reds and purples and the intense heats necessary to fuse the glass, it is unwise to expect the maintenance of great accuracy in color matching.

e. Glass: The same is true of colored plate glass and the so-called structural glasses. The latter may be had in various mottled and striated effects, some resembling marble and some strikingly like polished wood.

4. MECHANICAL AIDS

If the type of product you deal with calls for a great variety of colors, your studio should be equipped with a few color aids. Picking colors out of the air or mixing them always on a palette is a haphazard way of doing things. You should therefore have a file of color swatches indexed for easy selection. All paint manufacturers put out color charts, some of them based on the Munsell system (Chap. XIII). They will be glad to supply you. A color wheel, mounted on a small motor with disks that can be spun to "mix" various color components, will be useful if your problems are frequent.

The Maerz and Paul *Dictionary of Color* or the Munsell *Book of Color* (see Chap. XIII and Appendix B) are almost indispensable. They will help you make color choices and, if your client also owns a copy, color specification can be made by letter or even by telegraph.

The colorimeter is a binocular device for matching colors accurately; with it you can apprehend minute variations which the unaided eye cannot detect. There are machines, too, such as spectrographs and spectrophotometers, which will analyze the components of a color with an accuracy impossible to the eye. You can plot a graph for future reference; some will even write

the graph for you! These costly devices, however, belong in the laboratory rather than in the design studio.

5. COLOR SPECIFICATION

We have already sounded a warning about making final color choices before full-size models are available. Frequently, however, your client will insist that you submit several color schemes long before that stage is reached. In that case, you must send sample swatches by mail from which his paint shop will mix batches of color.

The best form in which to present these small samples is, of course, in the finish and material to be used in production. You can spray lacquer, paint, or enamel of the proper color on small rectangles of the material that will be used, such as sheet metal. We have sometimes found that a high-gloss finish can be accurately represented by mixing artist's oil paints and spreading them on the back of pieces of color-clear glass with a palette knife. This enables you to experiment until you have just the color you want. Then, when the paint dries, protect the back with cardboard or steel and bind them together with cloth or paper tape.

XXIV · Materials and Processes

LET US SUPPOSE that you have set yourself up as an industrial designer. A prospect has asked you to quote a fee for redesigning a machine made to administer anesthetics. It falls in the classification of commercial equipment because it is not consumer owned, but is used to render a service to the public. Hence it will not be made in big quantities like kitchen ranges and smoking stands. It is a precision instrument; the delicate balance between life and death may hang on its proper functioning.

Before making a quotation at all you must go over the machine carefully to find out what materials are used and by what processes the many parts have been produced. Later, if you get the contract, you will, of course, make a more detailed study.

The machine is small, yet in it you will find combined many of the metals and most of the processes common to modern manufacture. Let us begin at the base. It is a *gray iron sand casting*. The operating part of the device is supported, adjustably, on a length of *seamless tubing*, fitted into the base. A rack which slides on the tube supports cylinders of oxygen and N_2O ; it is a *zinc die casting*. Many other die-cast parts are used for manifolds, mixing chambers, etc. Certain valves are of *brass*, other parts of *phosphor bronze*. There are three sets of *molded rubber bellows*; two of them are in circular form, enclosed in cases which have been *spun*. The third bellows, which expands and contracts with the patient's respiration, is mounted at the back and enclosed in two *steel stampings* provided with a *fabricated* cover. There is one *aluminum sand casting*. An adjustment wheel is made of *brass bar stock* chromium-plated and fitted with an *etched brass plate*. Two pressure gauges have *stamped steel* shells and are fitted with *lithographed* dials and *glass* crystals. There are two *molded plastic* knobs and several lengths of fabric-covered *rubber tubing*.

To make this device, most of the common machining processes have been called into play: *threading, boring, tapping, reaming, turning, grinding, milling, broaching*, and even *lapping*. The iron base requires *disk grinding*. Finishing processes include *chrome-plating* for die-cast parts and metal tubing; *buffing* and *polishing* for the aluminum sand castings; *masking* and *spray painting* for spinings and steel stampings, *sand blasting* for the *vitreous enamel* base.

When commercial artists and young architects not dry behind the ears rush into industrial design because they think it a sinecure, is it any wonder they make such a sorry mess of things and give the profession a bad name? I have said before, and I wish to repeat, that industrial design is half art and half technology. You must be an artist first and foremost, but if you lack even a bowing acquaintanceship with these practical things, you will be lost as completely as the babes in the woods.

A CATALOGUE

When adequate teaching becomes more widespread, a textbook of materials and processes must be written for the industrial design student. It would be a volume larger than this, written by specialists, but edited by a designer. Only a designer could know just how to present technical material to the design student in its most graphic form and just where to draw the line between helpful information and overzealous detail.

A bare catalogue of materials and processes is about all that can be given here. Until such a book is written the student who cannot attend one of the few existing schools of industrial design (see Chap. VIII) will have to travel the hard road, acquiring familiarity with manufacture from textbooks not written with his needs in mind, from vocational schools and vocational lectures, from articles in trade journals, but chiefly from hard-bought experience in drafting room and shop.

In Chap. VI, the kind of practical knowledge that you must have was discussed. Let me repeat that you should not and cannot be expected to have a profound technical knowledge of mechanics, electricity, metallurgy, and the scores of intricate processes involved in industry. Engineers and shopmen live with these things day in and day out. You will have to rely on their special knowledge. To be a first-rater, however, you should have

a broad general understanding of these things and know at once into which category a particular operation will fall, and whom to call on for special information.

You will recall that certain types of products are not discussed in this volume: ceramics, glassware, textiles, silverware, jewelry, wallpaper, and furniture (see Chap. I). Therefore the precious metals do not appear in our catalogue, nor do fabrics or wood, except as they may be used in combination with metals.

Here is a broad classification of materials in the order of their importance to the industrial designer:

A. Metallic materials (iron, steel, brass, bronze, aluminum, zinc, Monel metal, white metal, and magnesium).

B. Organic materials, synthetically prepared (plastics and synthetic rubber).

C. Organic materials from natural sources (rubber, wood, and certain insulating materials).

D. Glass.

E. Finishing materials (paints and synthetic enamels; vitreous enamels; plating and other metal finishes).

It would be inconvenient to discuss materials and processes separately, because one process may be applicable to a number of materials, and, conversely, most materials can be manipulated in several ways. I shall, therefore, touch on the processes as they arise.

A. METALLIC MATERIALS

As an industrial designer, you will deal with metals more than any other material, unless you happen to become a specialist in designing for plastics or rubber. Metal is the backbone of modern industry. Before discussing individual materials, let us set up an outline of the forms in which the metals will be found just prior to putting them to the uses of product design. They are: (1) bulk, or make-up materials; (2) sheet, plates, and strip; (3) structural; (4) rod and bar stock.

FORMS

1. *Bulk.* This is the form (pig, billets, or scrap) in which various metals such as iron, zinc, brass, aluminum, etc., will be found before being melted and poured or forced into molds or dies for conversion into finished pieces. With any type of casting you have great latitude in the creation of freehand design forms. The principal conversion processes may be briefly described as follows:

a. Sand casting: Molten metal is poured by gravity into molds formed of moist sand, from which has been withdrawn a wooden or metal pattern which had the approximate shape and size of the casting desired. The metal is then allowed to solidify and is removed from the sand. Sand castings are not so frequently used in consumer products today as they used to be, but will be frequently met with in commercial equipment. Cast iron, because of its great strength and the size of pieces the casting process makes possible, is used, pound for pound, more than any other material in the capital-goods field.

b. Permanent mold casting: Also a gravity process like sand casting, except that the molds themselves are made of metal and no pattern is required. Permanent mold work is used in consumer and commercial products where sand casting is too slow and dies for die casting too expensive or not applicable because of size.

c. Die casting: Molten metal is forced by pressure (mechanical, hydraulic, or pneumatic) into steel dies or molds. Large quantities and fast production are possible, with great accuracy of dimension, so that machining is greatly reduced or even eliminated. It permits the use of fine design detail, lettering, etc. This process will be found widely in consumer and commercial products, but seldom in capital goods.

d. Slush mold casting: Molten metal is poured into a mold and then out again, leaving a shell to harden. It is a small-production process, applicable only to pieces of limited size. Used chiefly for lighting fixtures, toys, etc.

2. *Sheet, Plates, and Strip.* Most metals are obtainable in sheet form. Some sheet metals come in a great variety of thicknesses (gauges) from an extremely thin stock easily bent in the hands, to plates $\frac{1}{2}$ inch thick or more. The chief methods of converting sheet metal into products are: (a) fabrication, (b) stamping, (c) spinning.

a. Fabrication: "Fabrication" may be defined as a semimanual process of manipulating sheet metal by means of comparatively simple machinery either hand or power operated. It permits of forming the metal in limited ways on shears, quick-work machines, hammers, brakes, rolls, and radius formers. After the component parts of a metal casing are thus formed, they are fastened together by various means: rivets, bolts, self-tapping screws, etc., and various kind of welding. Fabrication will be found in all three types of design where comparatively small volume, or the nature of the product, does not warrant a large die expense.

b. Stamping: Stamping or drawing sheet metal is a fundamentally different process. It is fully automatic, requiring one or many successive operations to develop a given shape. The tremendous strides made in stamping techniques in recent years have given the designer much more freedom in the production of curved shapes and freehand forms. Stamping is applicable to consumer and commercial products, but will be seldom met with in capital goods.

c. Spinning: This is another semimanual process, not particularly common in high-production manufacture. By means of spinning, sheet metal can be formed with freehand curves in one plane and true circles in a plane at 90° to it (see Chap. XII, Fig. 94c). This process is useful in certain low-production runs, and in making parts which may later, when volume of sales increases, be changed to stampings.

These three processes may, of course, be combined in various ways. Stamped forms may be finished off by spinning, and fabricated parts are sometimes given finishing touches on stamping presses.

d. Forging, hot and cold, including cold heading: This is accomplished by hammering, upsetting, and squeezing steel, brass, bronze (metals of high tensile strength), giving them a tough structure and grain flow to accomplish the greatest utility. Although rarely met as an external part, forging may in the future, if given appearance attention, become a factor in industrial design.

e. Swaging: A hammering process applicable not only to sheet metal, but to metal in other basic forms. In production, it is usually an auxiliary process.

3. *Structural.* These include angles, channels, T-shapes, H-shapes, Z-shapes, and many others, in various standard sizes and weights. They may be used in building substructures or frames for styled equipment, but they are seldom exposed. You should know, however, what shapes are available. With the great advance in metallurgical practice, structurals are becoming lighter in linear dimensions and in the future may present new possibilities for design.

4. *Rod and Bar Stock.* These are drawn in wire mills, or extruded as in the case of aluminum, and may be obtained in many stock sizes and shapes. You will seldom be concerned with them, as these shapes are usually converted into screws, bolts, pins, etc.

Iron

Until the middle of the nineteenth century cast iron formed the bulk of all manufacture in the metal trades and it is only within comparatively recent times that it has given way to steel as a material, or to other more rapid and accurate methods of casting molten metals. It is impossible to cast iron to close tolerances, which means that pieces must be ground, machined, or otherwise treated in order to be used in accurate work. Laborious handwork is necessary to obtain a fine surface finish; for consumer goods its weight is a handicap.

Iron, however, is still a prime material, and sand castings will probably always be used for many applications because of its great strength when used in heavy sections, its durability, and its relative cheapness. You should learn the comparatively simple principles involved in foundry work so that your designs will be applicable to the medium and the progress it has made in recent years. Fine detail is unwise, decoration should be sparing, and radii and fillets should be made ample to facilitate the flow of the molten metal in its rather fragile mold.

Steel

As industrial designer you will probably deal with steel more than any other single material. In less than a century since Bessemer invented the converting process which took steel out of the almost precious-metal class and turned its use from fine swords and armor and delicate instruments to railroad rails,

gears, and stoves, steel has become the dominant material of modern commerce.

The tremendous strides taken in stamping techniques in recent years have made the uses of sheet metal so many that it is almost a new material. Sheet-metal fabrication, as specifically defined above, is an older art; but although some improvements have been made in recent years such as the use of radius-forming machines and improvements in rolls for making large curved forms, no great difference can be noted in the way steel is fabricated today and the way it was done thirty years ago, although welding techniques have changed greatly. The lighter gauges of sheet steel will be used extensively in designing consumer and commercial goods; the heavier gauges and plates are now commonly used for frames and housings in capital goods in place of cast iron.

There are many grades and types of steel. You may have to design a piece in one way for extra-deep-drawing stock, and in an entirely different way for other metals which are more difficult to draw, such as stainless which requires a newer and more special technique. Stainless is expensive when used promiscuously, but really is cheap when used in the right places. There are also stainless-clad steels in which a thin coating of stainless is bonded to carbon steel thus reducing the amount of stainless and, consequently, the cost.

Preplated steels find many design uses. This is a thin material, usually chromium plated, which can be had in various finishes, satin or bright, or striped with scratch brush finish in various ways. Some mills are producing prefinished strip in various colors which can be fabricated or formed.

Steel is also cast in sand molds, and will occasionally be met with if you work in the capital-goods field. Here the limitations are even greater than with cast iron and you will do well to consult carefully with the foundry before specifying any form that may cause difficulty.

Brass

Brass is seldom used in any exposed place without plating, because of its tendency to tarnish. Where a particularly fine finish is needed, such as on appliance hardware, bathroom fittings, etc.,

brass may substitute for steel or iron although it is more expensive. It will not rust even if the plating or other finish wears off; consequently, in cast and sheet form, it is used wherever contact with moisture is fairly constant.

Brass may be fabricated by most of the common processes. It can be sand-cast, die-cast, fabricated, stamped, or spun. Being somewhat more ductile than steel, it can often be drawn into shapes which are difficult for steel, although because of its higher price it is seldom used where steel will do just as well.

Bronze

Bronze is an alloy chiefly of copper and tin. It has great strength as well as resistance to both wear and corrosion. It is expensive and although used in machine parts where its toughness recommends it, you will seldom meet with it in mass production design. Occasionally it is employed in cast or deep-etched name plates for large and costly machinery.

Aluminum

Classed by our forefathers as little more than a curiosity among metals, aluminum has come to be almost as important to the industrial world as steel. Its lightness, its pleasant bluish-silver sheen, its unusual versatility, make it the choice for an infinite number of applications both in consumer merchandise and commercial equipment. It will seldom be found in heavy machinery, although for certain chemical and food industries it is often mandatory. Its widening use in structural and transportation fields is well known.

Aluminum may be had in sheets, structural and extruded shapes, and in various alloys suitable to sand casting, permanent mold, and die casting. Being extremely ductile, sheet stock lends itself well to drawing and spinning. The infinite variety of extruded shapes possible with little die expense are also of interest.

Only a few years ago it was difficult to paint or lacquer aluminum, but this difficulty has been overcome and it is now possible to obtain as good a bond between the metal and the paint as on steel. Plating aluminum, also considered impractical but a short time past, has finally been solved by the magic of the laboratory.

Another decorative possibility is the comparatively recent anodizing process, discussed in Chap. XXIII.

Zinc

Zinc in sheet form is too soft for most industrial product uses, unless reinforced by other stiffer metals. In the raw, the color and texture of zinc are dull and uninteresting, but in various alloys it can be die-cast more successfully than any other metal. Its use in hardware, box tops, metal picture frames, lighting fixtures, grilles, etc., make it of great interest to the designer. It takes plated finishes perfectly and is comparatively cheap.

Monel Metal

An alloy of nickel and copper, Monel metal is of great value because of its acid-resisting properties. It may be used for sinks and wash tubs in the home. For certain types of food handling and chemical equipment, Monel is indispensable. It comes in sheet form and may be cast by most of the familiar processes. It is rather expensive.

White Metal

This is used commonly in making patterns for sand castings. It has few product applications.

Magnesium

Still lighter than aluminum, magnesium alloys are beginning to find a place in the industrial product scheme. In the form of a die casting it was recently introduced as the main housing for a vacuum sweeper, where its lightness made a real selling story (see Plate 22). You will be pleasantly surprised at the many uses of extruded and sheet magnesium in the near future.

B. ORGANIC MATERIALS—SYNTHETIC

Synthetic Resins

The synthetic materials known as resins, products of the chemist's laboratory, are the seven-day wonders of the modern industrial world. Barely a generation old, their use has spread to almost every field of manufacture, and in many applications

they are pushing metal and glass hard for supremacy. The possible use of plastics in the manufacture of furniture, automobile bodies, airplanes, and houses is about the most exciting prospect the designer can look forward to.

In the proper use of plastics you will find a real challenge. Before their special beauties were fully understood, they were abominably misused, to the point where bad design definitely retarded their advancement.

The plastics were something brand new for the mass production designer. Here was a material that offered a chance for infinitely delicate detail; they were pleasant to the touch and lustrous, and offered an infinite color range. Small wonder that designers welcomed them with open arms.

All plastics belong to one of two general classifications. They are either (1) thermosetting or (2) thermoplastic. Thermosetting materials harden or set through the application of heat and pressure. Thermoplastic materials are given a definite shape by the application of heat and pressure, but retain that shape only upon cooling.

The thermosetting materials, once they have taken their final form, cannot be changed. The thermoplastic materials can be remelted, or ground up and used again.

Plastics are converted into final form by several methods: (1) compression molding, (2) injection molding, (3) casting, (4) extrusion, (5) lamination, and (6) rolling into sheets.

1. *Compression Molding.* Dry material in powdered, granular, or preformed state is introduced into hardened steel dies and attains its final form under pressure or heat, or both.

2. *Injection Molding.* The material is reduced to a plastic state by heat and pressure and forced into steel molds, like the die casting of metals. Films of plastic may also be forced over metal by this means.

3. *Casting.* The material is reduced to a liquid or viscous state and poured into molds. Analogous to permanent molding of metals.

4. *Extrusion.* The material is reduced to a plastic state and forced through orifices which produce rods of varying shape.

5. *Lamination.* A material such as paper or cloth is impregnated with the resinous material in a liquid state, a number of

sheets are superimposed one on the other and then put through rolls under heat and pressure.

6. *Rolling into Sheets.* Certain types of plastic materials are rolled into sheets of varying thicknesses; these can be obtained in transparent and opaque forms, and many degrees of translucency.

Plastics are produced in almost every degree of translucency from a material almost as transparent as glass to dense opaque substances.

The phenolic resins and the urea group are thermosetting, and therefore cannot be injected, cast, or extruded. Until recently the laminated plastics were confined chiefly to flat sheets, but newer techniques make it possible to give them a certain amount of forming, which makes them available for refrigerators, tiles, and many other products.

Lettering, numerals, and various kinds of decoration may be applied to plastic surfaces by the use of relief, intaglio, color wipe-ins, decalcomanias, stencils, branding, and various types of metal inlays.

Artificial Rubber

This, too, is a product of the laboratory and will interest the designer less than the technical man. Various compounds have special attributes. The technique of molding and extruding is about the same as for rubber.

C. ORGANIC MATERIALS—NATURAL

Rubber

Rubber in combination with metals is becoming a more and more frequent phenomenon in product design. Formerly the designer who worked in this material was usually retained by manufacturers whose special field it was. He designed tires, heels and soles, hot-water bottles, and other items usually made exclusively of this material.

But cases where rubber can be used as an integral and exposed part of the design are becoming more and more frequent: handle grips for bicycles and velocipedes; gaskets and breaker strips for refrigerators to harmonize in design and color with the rest of the cabinet; permanent wave clips for beauty parlors; solid molded

rubber bases for commercial equipment such as retail-store coffee mills and meat grinders; garnish moldings and insulators for washing machines; knobs and even handles for household appliances. These are but a few of its legitimate uses.

Rubber can be molded or extruded in a great variety of shapes. It can be extruded over metal to form bicycle saddles, sound-proof shelves for refrigerators, automobile running boards, and many other items. The delicacy of detail possible in the plastics can almost be matched in molded rubber, and by the introduction of pigments a fairly wide variety of colors can be obtained, although a white that will retain its original whiteness without turning yellow is still to be produced at a commercial price.

The designer should also be familiar with the various types of rubber bumpers, rubber feet, and other sound-deadening items which will be used on many types of products.

Wood

Unless you are engaged in styling furniture or wooden radio cabinets (fields not covered by this volume), the problems you will meet in wood will be few and far between. Its use for handles in combination with metal in housewares such as kettles, coffee-pots, casseroles, grills, etc., may arise, although here the plastics have largely supplanted it. Garden and farm implements, sleds, playground equipment, desk sets, carpet sweepers, souvenir boxes, silverware cases, and trays are a few of the other items in which you will encounter wood in combination with metals in the product field. These applications usually involve fairly simple shapes produced by turning, shaping, and bending processes.

Insulating Materials

Insulating materials (some are organic, others inorganic), although seldom exposed to the eye, often have an influence on exterior design, in such products as hot-water heaters, stoves, refrigerators, domestic heating equipment, electric cookers, etc. Loose insulation such as rock wool, "dry-zero," etc., may require an entirely different method of assembly from packaged insulating materials like kraft paper.

D. GLASS

Glass is another material which, in many of its familiar forms such as tableware and containers, is not within the scope of this book. Being one of the oldest industrial substances, the literature is enormous. Therefore processes such as paste-molding, semi-automatic molding, and full automatic iron molding will be of no interest here.

Cast glass, however, because of its frequent use in conjunction with metal in casserole lids, percolator tops, stove lamps, etc., should be part of your repertoire of processes. Familiarize yourself with some of the special grades of glass, such as heat-resistant, opalescent, etc.

Flat glass, also, will be frequently met with, because of its use in display cabinets, gasoline pumps, hydrated compartments in refrigerators, and as inspection ports in industrial and food machinery. You should know about the various kinds of flat glass and their special properties, window glass, plate, laminated, shatter-proof (tempered), and structural (colored and marbelized materials).

Flat glass can be curved *in one plane only*, by laying the sheet across a comparatively inexpensive steel form and heating it to a dull red. The sheet then sags and takes the shape of the form.

Surface decoration on glass can be produced by etching with acid and sandblasting through rubber stencils. Lettering and other designs can be inlaid, or painted into etched or sandblasted surfaces.

E. FINISHING MATERIALS

Industrial finishing processes can be roughly divided into two classes:

1. Finishes applied to a surface by mechanical or manual means (spray, dip, or hand), or by a combination of both (paints and synthetic enamels; vitreous enamels).
2. Finishes deposited upon a surface electrolytically (plating, anodization).

Most of the finishes coming within the first classification have already been mentioned in Chap. XXIII. Plating processes

involve an extremely complicated technique and it is hardly necessary for you to become deeply involved in their chemistry.

Most of the metals listed in this chapter, steel, iron, brass, zinc, and even aluminum, may be plated. For exposed parts, chromium and nickel are the commonest platings, copper being seldom used as a final finish because it changes by oxidation due to gases and chemicals in the air. Copperplating, however, is important industrially as a preparation for chromium in the copper-nickel-chromium plating sequence. The precious metals such as gold or silver are rarely used, and then only in small quantities because of expense. Cadmium plating is also seldom employed on exposed parts, except as a protection against rust, because of its rather lusterless appearance.

The hard brilliance of chromium may be modified by preparing the plated surface with wire brushes (Butler finish), thus producing a matt effect which is often more desirable than a high polish. The same is true of nickel.

New methods of coloring metal by depositing dyes on the surface have recently been perfected. After aluminum is anodized, it can be colored; even chromium plate may now be obtained in a wide range of colors.

Keeping abreast of the constant stream of new materials, processes, and finishes is a task in itself. The best way is to be in the thick of it, serving a number of different clients in diverse fields of industry. You hear about new developments constantly; discuss them with your informant and ask countless questions. Read the trade magazines and watch the advertisements. If a new material or finish seems to be of sufficient interest, write for information and samples, or ask a representative to call on you. In that way the available materials and processes finally become part of your working equipment. Do not forget that processes and materials often of themselves *suggest* design. Industrial styling cannot be practiced in a vacuum, out of touch with the tools that make it possible.

XXV · A Free-lance Design Group

SEVERAL industrial-design groups, under the style either of partnerships or of an individual name, have operated in this country for a number of years with staffs ranging from six to half a hundred—perhaps more in rush periods. They are presumably prepared to offer to industry a complete design service. Some serve a large number of clients at one time. There are also many individual designers, serving perhaps two or three clients.

Whether a manufacturer should ally himself with an organization or an individual is a matter for him to decide. There is much to be said on both sides. The individual designer with a few clients may give closer personal attention to the problems of each. A properly organized group, on the other hand, can pool the ideas of several versatile designers and, as a problem is tossed back and forth, dozens of ideas and possible solutions may come to light which would not, in the very nature of things, have sprung from one man's mind, no matter how fertile.

Large or small, the success of any group will, of course, be no greater than the sum of the abilities of its leader and its members.

Really large groups can afford to employ specialists for certain phases of the work, although too great specialization may be detrimental rather than helpful. Production-line methods are seldom conducive to the best results. If one person, for instance, is continuously employed in making airbrush drawings of someone else's designs, his work will soon become perfunctory. An enthusiastic designer knows no satisfaction quite like that of creating a successful product from the first conception to the finished article.

This chapter describes an industrial-design organization for the information of those who wish a further insight into the mechanics of design production and business management.

ORGANIZATION

The free-lance designer who works by himself, with perhaps one assistant and an office girl, need not be unduly concerned with matters of organization. He probably serves but two or three clients, among whom he divides his time according to an agreed schedule. Bookkeeping is simple and when rent, salaries, materials, and incidentals are paid, he pockets the difference between their total and the aggregate of his fees.

But when the organization grows to a dozen, and a greater number of clients are on the books, much attention must be given to management if the group is to operate effectively. Industrial design is a business as well as a profession and, since the designer deals with business men, he must take care that the routine phases of his transactions are carried on in an orthodox manner and with as much dispatch as in any well-run business.

In the ensuing pages we shall assume for the sake of discussion that our group numbers between eight and sixteen, including the necessary business and clerical staff. To assemble such a group, or to train each member to the point where he possesses the necessary versatility, is no light matter. Nor is it simple to keep it functioning smoothly, without the rasped nerves and exasperating though often harmless jealousies that seem to be common to all groups.

THE STAFF

In addition to creative design, every major industrial problem involves renderings, models, mechanical drawings, color specifications and some lettering. If each member of the group were versatile enough to turn a hand to all of these somewhat mechanical phases of the work, it would be ideal. Actually, it may not be strictly necessary, although every competent designer should be able to make clean and attractive visualization sketches, good perspective renderings, accurate clay study models, and tentative mechanical layouts with limiting dimensions, radii, and all special features.

Although an expert lettering man would be an asset, there is seldom enough work to keep even one man busy all the time. Every designer, however, should have some familiarity with type styles and at least one staff member should be able to make first-rate comprehensive dummies of trade-marks, name plates, etc. Finished presentation models and the final mechanical tracings from which prints are made are perhaps best left to specialists.

An engineer with general manufacturing experience is also an invaluable asset. He may not have specialized knowledge in all of the fields touched by the clients served, but he speaks the language of the shop and knows the limitations and potentialities of the common processes of manufacture. His ability to plan drawings intelligently and supervise the work of draftsmen will save much time. If an engineer is not a salaried member of the group, a consultant should be available and called in frequently when puzzling problems arise.

When the staff consists of half a dozen or more working on the boards at the same time, a studio manager or executive assistant should be appointed. He should be an experienced designer himself, thoroughly familiar with all the techniques employed, and capable of directing the work in all of its phases. He must be conversant with all major jobs from the beginning. It is, therefore, important for him to be present at preliminary conferences with the client.

It is the job of the studio director to plan the work so that, as soon as any one staff member has finished a given task or has reached a point where, for one reason or another, it cannot be carried further without obtaining additional data, he will be given another immediately. Lost time will be charged to general overhead and must be kept at a minimum. If the group is working either on salary or salary plus bonus, every hour of the day must be employed on gainful work if possible.

Many different jobs for different clients may be going through the studio at one time. They may be large and they may be small. Large jobs sometimes break down naturally into several component parts which can be treated almost as separate jobs. Although it is desirable to interrupt each designer's train of thought as little as possible, it may be necessary, on rush work,

WORK SHEET

for Week of

| | |
|--|--|
| | |
|--|--|

| | JOBS | NO. | REMARKS | DELIVERY |
|--------|------|-----|---------|----------|
| SUN. | | | | |
| SAT. | | | | |
| FRI. | | | | |
| THURS. | | | | |
| WED. | | | | |
| TUES. | | | | |
| MON. | | | | |

Fig. 172.

to divide a single project up among a number of staff members. It is the task of the studio director to make assignments so that the various parts reach completion at about the same time.

SCHEDULING THE WORK

Verbal scheduling of work should be avoided. A work sheet should be prepared and handed to each staff member with written instructions on each job; this can be done daily or once

| NAME _____ | | DATE _____ | |
|------------|------|------------|-------|
| JOB | ITEM | CLIENT | HOURS |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

FIG. 173.

a week. In most cases a weekly work sheet will suffice, with spaces for the day of the week, description of the job, date when completion is expected, and a space for remarks or special instructions. Many times unforeseen incidents will interrupt the schedule. In that case the work sheet should be corrected in writing. Figure 172 shows a sample of such a work sheet.

As soon as the client gives the signal to go ahead on a particular job, it should be entered in a journal with a job number, description, name of client, and the date when completion is required. Care should be taken to make job descriptions as

brief as possible consistent with clearness. Current jobs should then be posted prominently on a bulletin board or blackboard located where it can easily be seen by all, so that time cards can be filled in at the end of the day with the least effort.

Since accurately kept time records form the heart of the cost system to be described later, their importance cannot be overestimated. Every employee, except clerical workers, should fill out one of these cards at the end of every day, giving the time

[illegible]

FIG. 174.

he worked on such and such a job in units of $\frac{1}{4}$ hour; every hour of the day must be accounted for. If nonproductive work is being prepared, such as drawings for promotional literature issued by your own organization, it should be treated the same as a job for a client and entered on the time card with number and description. Figure 173 is a suggested form for such cards, printed on a light Bristol, 4 by 6 inches.

The time cards are then turned over to the bookkeeper and at intervals all daily entries are taken off on a recapitulation card of similar size but different color, as in Fig. 174.

From these the time studies and cost analysis are made. If certain work is being done for a client on a cost-plus basis, it is obvious that this record must be kept strictly accurate and up to date. No matter on what fee basis the account is being handled, this record, converted into the monthly cost analysis, provides the figures by which the head of the organization knows whether or not a profit is being made and gives him the necessary history on which to base estimates and quotations for future business.

METHODS OF HANDLING

With a major project of considerable importance, the conference method of attack will be found to save much groping at the outset and to develop many "leads" at once. Let us suppose that the preliminary data—photographs, catalogues, and other material—as well as a sample of the actual product, have been accumulated. The problem is laid before the entire group around a conference table, designers, modelers, draftsmen—everyone who will later be involved in its solution.

Perhaps a representative of the client's engineering or sales staff is present. The known objectives to be attained are described and the limitations stated. Cost and selling price differentials are discussed. Activities of competitors are described and the merits of their products, or lack of them, discussed. Sketch pads are available and several new approaches suggested on the spot. One suggestion begets another; a single idea catches on like a brush fire in a high wind. In this way new approaches of considerable value can often be begun and carried a long way toward solution in a brief time.

Later the various ideas so developed can be worked over more intensively by several individuals on the staff at their own drawing boards and presented at subsequent staff meetings for criticism.

Jobs of smaller proportions—a plastic radio, a small humidifier, a space heater—might best be handled from the beginning by a single individual who receives occasional criticism from others. He alone makes the rough sketches, the study models in clay, the presentation drawings, and the preliminary mechanical layouts. When the client's O.K. has been obtained and the final scheme of the design is set, the balance of the work—presentation

models and mechanical drawings—may be turned over to others for completion under the direction of the originator of the design.

FILING

The importance of signing, dating, and filing away drawings of all kinds has been emphasized in the chapters on design patents, rough sketches, and mechanical drawings. It remains to discuss the physical details of filing and preserving them for both active and closed accounts.

Active Accounts

When a project is in preparation (especially if more than one person is involved in the work), all data and drawings must be available to each worker at all times. Therefore they should be kept in some common place rather than on one man's drawing board. All rough sketches relating to each job should be rigorously weeded out at least once a week and placed in a file folder in some accessible place until the entire job is completed.

Blueprints supplied by clients may be of every conceivable size and therefore difficult to file in any standard equipment. Moreover, folding large prints is a nuisance; rolling and unrolling makes them equally awkward to handle. They will be more usable if arrangements are made to hang them in racks at right angles to the wall, each rack conspicuously labeled for easy identification. We have devised a filing cabinet in which *all* material—prints, rough sketches, photographs, client's catalogues, and correspondence relating to the "active" designs—can be kept together. It consists of a series of compartments arranged in pairs vertically, the lower compartment 44 inches high, the upper compartment 10½ inches. The upper compartment accommodates a number of standard Manila folders containing rough sketches, catalogues, etc. The lower compartment is fitted with a metal rod attached to its upper surface. Blueprints and large layouts are held together with a strong spring clip and hooked to this rod. Each pair of compartments is labeled with the name of the client and the job number. The width of the compartments, of course, is dependent on the amount of material one expects to handle.

Closed Accounts

As soon as a project has been completed, all sketches, renderings, and drawings should be put away in permanent files. If the sheet sizes (11 by 17 and 17 by 22) recommended for rough sketches in Chap. XV are adopted, any standard vertical filing cabinet may be used for storing rough sketches. These should be folded carefully and none put away without signature and date. If a staff member should neglect this duty, the date may often be traced back by reference to his time card and marked on the sketch before filing.

Whether rough sketches are filed consecutively by name and job numbers or by clients is a matter for individual decision. The effectiveness of any filing system depends upon its simplicity. Any method will suffice which makes this material fully accessible when, for any reason, it must be referred to again.

Tracings, whether on active or completed jobs, are best kept in regular wooden or metal cabinets built for the purpose to protect them from dust and misuse. If you can afford the luxury of fireproof tracing cabinets, you are in luck. If not, a print should be made from each tracing and deposited in a fireproof vault or duplicates kept in another building to diminish loss in case of fire.

There are many methods of indexing tracings. A simple one is as follows: Each sheet size is given a descriptive letter such as *A* for the small size, *B* for the next larger, and *C* for the largest. *A* tracings are numbered, say, from 1 to 999; *B* from 1000 to 1999; and *C* from 2000 up. Thus the number itself designates the size of the drawing. Tracings within these sizes are then numbered consecutively as completed, regardless of client or job. A given job may therefore consist of one assembly drawing on the largest sheet, No. 2355; two drawings on the middle-sized sheet, Nos. 1720 and 1721; and six details on the small sheets, Nos. 621 to 626.

A card index is made, with a form printed on 3 by 5 cards. One card lists all tracings made for each job, and the cards are filed alphabetically by description (such as "Wringer" or "Furnace front") under the client's name.

A still simpler method is to list drawings in a journal, which is divided into parts, one part for each sheet size. In the *A* section

the entries will be listed consecutively from 1 to 999, etc., as in the card system.

In some cases drawings must be made which are larger than any of the standard sheet sizes. These can be numbered in the *C* or largest series and then rolled and put in an odd-size file. It is important to make a notation in the journal to that effect: for example, "No. 2025, odd."

To avoid confusion it is advisable to enter a blank sheet in the tracing file to take the place of the "odd" tracing. The blank sheet will carry the tracing's number, title, client, etc., and will also tell where the tracing is located.

It sometimes becomes necessary, as the design progresses, to make radical changes in a drawing. In this case it may be better to make an entirely new drawing to take the place of the old one. The old drawing, however, should not be destroyed. Rather, it should be marked VOID (preferably in red pencil right across its face so that it cannot be used again by mistake), giving the date voided. Then, anywhere on the sheet where it can be easily read, make the note "Superseded by Dwg. No. . . ."

When the new drawing is completed a note should be made: "This drawing supersedes Dwg. No." Even if no new drawing is made, an incorrect drawing should always be voided.

Every attempt should be made to keep tracing files complete and not permit the sequence of numbers to be broken. However, removal of a tracing is sometimes unavoidable. If it has to be done, be sure to have a written request from the client, for, with the tracing, goes your only dimensioned record of the design. Again, enter a slip sheet in the file with the number and date, mentioning when and where the drawing was sent.

All drawings for which the designer has been paid, are really the property of the client. The designer is merely their custodian. It is therefore all the more necessary that they be kept safely and in good order.

Insurance may be obtained on sketches, tracings, and models, and it is important to have them thus covered. Active work has an actual cash value which can be computed on the basis of time plus material and overhead. Therefore time cards representing active work form your chief record for the insurance company adjusters, and should be put away in a safe. Completed

drawings on inactive accounts have only a potential value in case of litigation or demand from the client. Therefore they are not insurable.

OTHER RECORDS

Misunderstandings and annoyance will be avoided if all outgoing drawings and models are accurately and systematically recorded. A journal should be kept in which every item that leaves the premises may be entered, with the date, job number, client, and description, such as: "Three hard pastel perspective renderings, Deep well pump," or "Prints Nos. A-505 and C-2283, 2284, Aerozone cabinet." Note should be made whether the item was sent by mail, express, or messenger. It is easy to walk out the door to visit a client with a group of drawings under your arm and forget to record them in the journal. These will be just the drawings that are lost en route or mislaid at the client's plant and cause embarrassment later if there is no written record. The journal should also contain reference to all returned material.

Postal insurance receipts and duplicate express slips should of course be kept on file until no longer needed, providing another record of outgoing shipments. Drawings and models should always be insured in transit.

MATERIALS

In the practice of industrial design, tools of the trade, with the exception of the airbrush and various machines that may be part of model shop equipment, are not expensive in themselves. Pencils, paper, pastels, crayons, water-color tube paints, T-squares and triangles, wrapping materials, mat board, and the ordinary drawing instruments are not "materials" in the sense of materials of manufacture—steel, iron, brass, aluminum. Therefore the item called "studio expense" on your ledgers may not seem large in comparison with items such as salaries, travel expense, and rent.

But it is easy to regard them as a minor expense and use them prodigally to the point where they assume almost major proportions. Sketch pads may seem cheap enough, but when you begin using them for scratch paper or ruin an entire pad by sticking thumb tacks through it, the expense may become serious. Com-

mon sense and a little careful supervision will keep this phase of studio running expense in the place where it belongs—a minor matter. Since many small articles are bought in quantities, it is well to have all materials ordered by one member of the organization and dispensed by him as needed. Cost of special materials, used for only one account, should be recorded and included under direct expense on the cost analysis.

Equipment and materials for the model shop have already been listed in Chaps. XVII and XIX. In the design and drafting rooms, materials and instruments used will not differ much from those used in a commercial art studio and in the engineering department of any plant.

LIBRARY

Art books are expensive, but a certain proportion of income should be put aside each year for the acquisition of standard works on design, architecture, and the allied arts. The art section of the nearest large library or the library of a large art museum should be consulted and a list of books made up for future acquisition.

A clipping file, classified by subject, should also be formed. Current consumer magazines contain photographs in their advertising pages that should be clipped. Certain progressive trade journals in various fields publish sections devoted to appearance design. These magazines should be kept on file for a year, then clipped. Valuable articles on processes, finishes, etc., frequently appear; these can be preserved in separate folders.

FINANCIAL RECORDS AND COST ANALYSIS

A design organization, whether a corporation, a partnership, or a proprietorship, is subject to the same taxes, state and federal, as any other business. It must report on compensation and employment. It must carry insurance on its furniture and fixtures, and perhaps it will participate in some group insurance plan. In order to make the necessary reports and pay the due share of taxes, its records must be in perfect order at all times.

These records reveal to the corporation official, partner, or proprietor the profit trend of the business and indicate what steps are necessary to increase or maintain a profit trend or to deter-

mine where changes and reductions in overhead should be made to avoid possible loss. Accurately kept records serve well in securing bank credit when needed, and the possibilities of expansion may depend on the profit curve.

It would be superfluous to discuss the accounting system here. Standard practice should be followed and accounts audited at regular intervals as in any other business. Efficient bookkeeping is not the job for an amateur, and should not become a part-time duty of a designer unless absolutely necessary.

Being a service organization, however, and a new type of service organization at that, a method of determining costs should be developed, because it is vital to profitable operation. Inasmuch as profit can be expected only when income exceeds expense, fees must be based upon knowledge of actual costs rather than upon estimates or guesses. Treatment of service costs differs somewhat from material costs, and care should be taken to record properly all expense to be considered later when a fee is computed.

After experimenting with various plans, all more or less unwieldy, we finally developed a method which will bear detailed description here.

Let us repeat that the basis of this cost accounting system is *accurate time records*. The average professional man, when asked to fill out a time card, usually does one of two things. Either he pads it in order to give the impression that he is doing a lot of work, or else he forgets and just makes a fair approximation of what he thinks his working time on each item has been.

In order to get time records which are really accurate, each individual must be impressed with the fact that these reports have absolutely no disciplinary meaning. He must fill in the exact amount of time spent on each assignment. If he hasn't enough work to do to fill an 8-hour day, it is the fault of the boss or the studio manager, not of the individual designer or draftsman.

When the time record is complete for the month, it is dealt with in two classifications:

1. Productive time (chargeable time spent on client's work or on special organization projects).

2. Nonproductive time (unassigned time which cannot be charged and is absorbed in overhead).

The productive time should include every item of business which has a name and a job number. Productive time spent on behalf of the organization itself may include solicitation of new business and the preparation of publicity, brochures, sales portfolios, or other special studio projects. These may each be given a regular job or account number, or may be combined under "New Business." (In most cases the cost of this time eventually becomes overhead expense.)

Nonproductive time includes all unoccupied hours and any miscellaneous time spent by a designer or draftsman on routine work, such as filing of sketches, keeping of records, purchase or arrangement of materials, etc.

Our first task then is to compile from the recapitulation cards a complete time study. For example, let us suppose that there are five designers on the staff and that six accounts are being handled. The organization works a $7\frac{1}{2}$ -hour day, with $3\frac{1}{2}$ hours on Saturday, making an average of 175 hours per month to be accounted for by each designer. Table I gives the complete time picture for a month. (Observe that the minimum time unit of $\frac{1}{4}$ hour is represented by a decimal.)

All office time (clerical, stenographic, telephone, bookkeeping, and other duties) is included in the final accounting as 100 per cent, since a definite breakdown of these duties with distribution by accounts, would be too involved. Therefore, after adding up the total number of hours spent by all individuals engaged in office work, their time is distributed in direct proportion to the total of hours spent on each account by all others.

For instance, referring again to Table I, the total number of studio hours spent during the month on Account A is 135.25 hours and the total number of hours spent on all accounts by all designers is 807 hours. Therefore 16.7 per cent (see Table III) of the total studio time was spent on Account A, and this account should be charged with 16.7 per cent of 175 office hours, or 29.2 hours.

We now have a complete record of time directly allocated to the various accounts. Our next step is to figure the cost of this

time. For the purpose of this demonstration, the number sign (#) is used in place of any definite monetary symbol. The reader can imagine, therefore, that it means £ sterling, gulden, drachmas, or anything he wishes. The total time cost shown on Table II, #63.02, would of course be ridiculous if it represented only \$63.02.

TABLE I.—TIME (ONLY)

| | Jones | Lowry | Peters | Norton | Evans | Total studio time | Office time | Total time |
|--|-------|--------|--------|--------|--------|-------------------|-------------|------------|
| Account A | 1. | 125.25 | 4.5 | | 4.5 | 135.25 | 29.2 | 164.45 |
| Account B | 32.75 | 20. | 40.5 | 13.5 | 4.5 | 111.25 | 24.2 | 135.45 |
| Account C | 3.25 | 23.25 | 16.25 | 26. | 27.25 | 96. | 20.8 | 116.8 |
| Account D | 5.75 | | 101.75 | | 49.25 | 55. | 11.9 | 66.9 |
| Account E | 4. | | | 56.25 | 32.25 | 194.25 | 42.2 | 236.45 |
| Account F | 80.75 | | | 64.5 | 51. | 196.25 | 42.5 | 238.75 |
| Account G (new business or special projects) | 18.5 | .5 | | | | 19. | 4.2 | 23.2 |
| Total | 146. | 169. | 163. | 160.25 | 168.75 | 807. | 175. | 982. |

The hourly rate of each member is now determined by dividing his monthly salary by the average number of working hours per month. The total cost of office time is also established (the sum of all office salaries), and the cost of that time determined in like manner. It is now a matter of multiplying each member's hours by his hourly salary rate to obtain the total time-cost for each account (Table II).

Comparison of Tables I and II shows that the total time-cost for designer Jones, who worked 146 hours of chargeable time at #0.10 per hour, is #14.60. Lowry worked 169 hours at #0.07 per hour for a total of #11.83, and so on. The total time cost for the month, including office time (one person at #0.05), is #63.02.

Now we have the cost of all time directly distributed to each account. On Table III various other expenses are added to these totals in the third column, such as travel, blueprinting, long-distance telephone, telegraph, in fact any expense which can be

directly allocated to a certain client. These items are recorded from day to day, as incurred, and totaled at the end of the month. Expense incurred in developing new business (other than time cost) is likewise added to the New Business account (Account G). This gives in Column 3 the total direct cost of each account or project.

TABLE II.—TIME COST

| | Jones | Lowry | Peters | Nor- ton | Evans | Studio time cost | Office cost | Total cost |
|------------------------|--------|--------|--------|-------------|-------|------------------------|----------------|---------------|
| Rate per hour. | #0.10 | #0.07 | #0.06 | #0.06 | #0.05 | | #0.05 | |
| Account A. | # 0.10 | # 8.76 | #0.27 | | #0.23 | # 9.36 | #1.46 | #10.82 |
| Account B. | 3.27 | 1.40 | 2.43 | #0.81 | 0.23 | 8.14 | 1.21 | 9.35 |
| Account C. | 0.32 | 1.63 | 0.98 | 1.56 | 1.36 | 5.85 | 1.04 | 6.89 |
| Account D. | 0.58 | | | | 2.46 | 3.04 | 0.60 | 3.64 |
| Account E. | 0.40 | | 6.11 | 3.37 | 1.61 | 11.49 | 2.11 | 13.60 |
| Account F. | 8.08 | | | 3.87 | 2.55 | 14.50 | 2.12 | 16.62 |
| Account G. | 1.85 | 0.04 | | | | 1.89 | 0.21 | 2.10 |
| Total cost of time. . | #14.60 | #11.83 | #9.79 | #9.61 | #8.44 | #54.27 | #8.75 | #63.02 |

The next item to be distributed proportionately to each account is the overhead expense, or burden. This includes rent, light, heat, supplies, insurance, taxes, postage, telephone and telegraph (where not directly chargeable to a particular account), depreciation, promotion, repairs, legal expense, etc. This overhead is easily determined by subtracting the total direct expense of all accounts (Column 3) from the total monthly operating expense shown on the Profit and Loss sheet. For instance, if the total monthly expense was \$122.65, and the direct expenses for the same time amounted to \$71.47, the difference, or \$51.18, would represent the overhead or burden.

The overhead (Column 5) is then distributed over all accounts in the same proportion that the number of hours worked on *each account* bears to the total number of hours worked on *all accounts*. Referring to Table III, you will note that Account A used up 16.7 per cent of all chargeable time in the month. To that account is therefore charged \$8.55, which is 16.7 per cent

TABLE III

| | Percent- age of total time | Total cost of time | Travel and other direct costs | Total direct expense | Over- head | Total cost of account | Income | Profit and loss | Year to date |
|---|-------------------------------------|--------------------------|---|----------------------------|---------------|-----------------------------|---------|-----------------|--------------|
| Account A..... | 16.7 | #10.82 | #1.13 | #11.95 | # 8.55 | #20.50 | # 30.76 | #10.26 | # 36.26 |
| Account B..... | 13.8 | 9.35 | 1.02 | 10.37 | 7.06 | 17.43 | 23.98 | 6.55 | 20.41 |
| Account C..... | 11.9 | 6.89 | .78 | 7.67 | 6.09 | 13.76 | 19.76 | 6.00 | 6.00 |
| Account D..... | 6.8 | 3.64 | .09 | 3.73 | 3.48 | 7.21 | 7.21 | 7.21 (loss) | 7.52 |
| Account E..... | 24.1 | 13.60 | 1.07 | 14.67 | 12.33 | 27.00 | 50.00 | 23.00 | 80.25 |
| Account F..... | 24.3 | 16.62 | .82 | 17.44 | 12.44 | 29.88 | 40.50 | 10.62 | 52.14 |
| Account G..... | 2.4 | 2.10 | 3.54 | 5.64 | 1.23 | 6.87 | | 6.87 (loss) | 21.73 (loss) |
| Total..... | 100.0 | #63.02 | #8.45 | #71.47 | #51.18 | #122.65 | #165.00 | | |
| Total profit..... | | | | | | | | | |
| Profit as shown on books (for comparison only)..... | | | | | | | | | |
| Difference..... | | | | | | | | | |
| | | | | | | | | #42.35 | #180.85 |
| | | | | | | | | #42.32 | 180.79 |
| | | | | | | | | # .03 | # .06 |

Note: The number sign (\$) is here used in place of the dollar sign, and represents an imaginary monetary unit.

of the total overhead of \$51.18. We then have the total cost of each account (Column 6); by deducting the cost from the income column, we learn how profitable (or otherwise) each account has been for the period. Year to date totals are entered on each monthly cost analysis, thus indicating the trend of that particular account.

If an account is being handled on a yearly retainer fee basis, it is perfectly possible, during rush periods, that it will merely break even or show a loss for one month or even more. Then somewhat more than the normal profit in succeeding months should be expected to even up, so that at the end of the year that particular account will show a reasonable profit. In Table III, note that Account *D* shows a loss; this account is held on an annual retainer and will show a little better than normal profit later.

A project undertaken on a cost-plus basis is billed at the end of each month at the actual cost of time, plus overhead, plus a normal profit.

It should be noted that, by this cost plan, the proprietor (or each partner in a partnership) should be paid a salary just like any other member of the group, in order to provide a basis for computation of costs.

By including sums representing miscellaneous income such as interest from investments or deductions not directly involved in the formal analysis, the resulting figure should compare very closely with the figures shown on the Profit and Loss sheet. Slight variations may result due to the impracticability of extending an uneven overhead percentage more than two decimal points. The discrepancy, however, should be negligible. Table III shows a discrepancy of \$.03.

WHAT THE ANALYSIS SHOWS

Many separate records of the account for each client may be taken from this analysis. Such information as total time, total time-cost, total direct expense, income, and profit and loss figures may be compiled to show the complete case history of any single account. The percentage of overhead carried by each client may also be found, as well as the percentage of total profit. Percentages of total productive and nonproductive time can also

be determined. Quick comparison of ratios between overhead expense and profit can be made, and a check made of the expense of new business and of any special campaigns.

If it is desired to determine the approximate cost of an account at any time during the month before the cost analysis has been made up and percentages of overhead distributed, you can take the exact cost as shown on the preceding month's analysis, and add the cost of time consumed as shown to date in the recapitulation cards, plus an average overhead figure.

The overhead figure in a design business is likely to vary rather widely from month to month. There are peaks and valleys, rush periods and lean periods. A manufacturer may lay off half of his labor during depressed periods, but this cannot be done so readily with highly skilled professional men. Therefore, even if business is slow, salaries and overhead remain quite constant.

An overhead burden of from 75 to 100 per cent might be considered about normal for a design organization, if it is efficiently run. If it goes much higher, it indicates an unusual amount of nonproductive time, or a period when members are on vacation with pay, or perhaps an excessive amount of promotional expense. Overhead at times may run as low as 65 per cent, indicating unusual activity, with almost every hour of the month accounted for on gainful work.

Low overhead should be a positive indication of good profit. If it is low and little profit shown, something is wrong. Conversely, a high overhead figure will usually indicate small profit or even a loss in any given period.

SALARY OR BONUS?

The question of recompense for members of the organization remains for discussion. It is quite possible to maintain a design group on a straight salary basis, but the advantages of a bonus system are considerable. Each designer is presumably a creator in his own right and men and women of that caliber have a right to feel that they are more than mere salaried employees, even if the salaries are adequate. If they are given a share in the business in the form of a bonus in addition to salary, the spirit is likely to be better. Under such a plan, salaries may be slightly

less than they would ordinarily be for comparable services, thereby reducing the salary total, which is, and should be, the greatest single item of expense in any design business. But the individual makes it up in his quarterly bonus, with the chance of profiting still more if he works hard and contributes to the success of the group as a whole.

Part IV · Practice

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XXVI · Problems for the Beginner ·

UP TO THE present our discussion of design has been largely theoretical. It is time we chose a couple of actual problems and attempted to reduce theory to practice. The reader who expects nothing less than an airplane, or at least an automobile, will be disappointed. The examples given in this chapter involve problems enough to tax the ingenuity of designers who have been at it for years. A cigarette box or a soap dish, if approached seriously, with questions of sales, utility, material, finish, manufacturing technique, shipping, and costs probed to their depths, can become a major design problem.

The problems offered here are considerably more difficult than a cigarette box, but involve fewer complications than, for instance, a refrigerator or a duplicating machine.

Do not assume that the solutions given are final. They are not solutions, merely *approaches*; no problem is finally solved until the tools and dies are built and the product has been assembled and marketed, and has proved itself in actual sales. We are, so to speak, thinking out loud with pencil in hand and modeling clay at elbow.

Let us suppose that we have just begun work with a manufacturer of domestic heating equipment. He would like to improve the appearance of a line of gas furnaces. He manufactures several types: gravity, forced air, etc., each in several price ranges, but the large volume is in the low-priced line, highly competitive.

We foresee at once that cost is going to be a big factor. A few cents added to cost will be multiplied several times in the price to the consumer. But design economies have already been

effected by more efficient methods of drilling the ports in the burners and molding and burning the baffles. Therefore, rather than lower the price, which is already in line with competition, the manufacturer decides to spend a little additional money on appearance.

A visit to the showroom is frankly discouraging. We are the plastic surgeons, and here are our patients. Our job is to touch up their noses, straighten their teeth, and remove the freckles. The manufacturer knows his units are not much for looks, but they are his babies, and he has a justifiable pride in his offspring.

AN UGLY DUCKLING

This warm air furnace, our first face-lifting job, is a particularly ugly duckling. Like most equipment of its kind designed for the huge small-house market, it consists of a cast-iron body surrounded by a fat cylinder of galvanized sheet metal. Surrounding this is a bonnet of the same material in the form of a truncated cone, from which, like the tentacles of an octopus, radiate the ducts. Close to the floor is a cast-iron plate on which are arranged various controls: motor-control unit, automatic pilot, regulator, valve, manifold, etc. For slightly higher priced models there will be a humidifier pan.

We observe that the cylinder is made up of two long sheets wrapped horizontally over a T-section floor ring and drawn together at the back by bolts. An opening is cut in the lower sheet for insertion of the control mountings. The furnace is shipped K.D. (knocked down), with these sheets rolled tightly together. This precludes prefinishing the sheets, for by the time they were installed by the erection man, they would be marred and scratched beyond recognition. The bonnet (the truncated cone already mentioned) is shipped blank, and the holes cut on the job by the erection man to fit the ducts, depending on the requirements of the particular house.

We are faced, therefore, with a startling array of "don'ts." We can't paint the sheet metal. There is no use trying to make the cylinder into an oval (foolish on the face of it), or square (that's another class of furnaces made by the same company, requiring an angle-iron frame), or hexagonal (expensive to form the metal). The bonnet can't be a stamping (enormous dies, and

the holes have to be cut on the job anyway). Apparently anything we try to do to the main body of the furnace would cost so much that it would be put immediately into a higher price bracket, competing with another unit in the line.

So we are left with the control group; pilot, regulator, and valves. We suggest that it be housed in completely, by means of a form or series of forms, which would cover the miscellaneous assemblage of smaller shapes and give a certain unity to the whole furnace. This suggestion meets with some interest, so we gather all available data and set to work. First we determine the

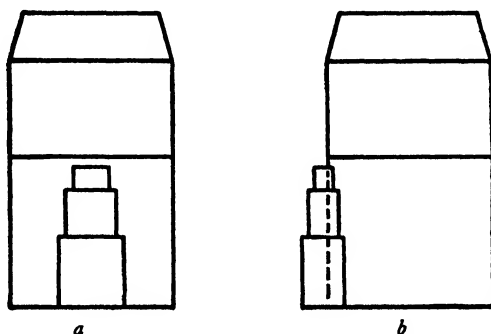


FIG. 175.

clearances necessary to house all the controls, as in Fig. 175*a* and *b*.

In other words we have three roughly cubical shapes superimposed one upon the other, starting at the floor and extending more than half the height of the cylindrical body of the furnace. The bottom cube takes care of the manifold and regulator; immediately above the regulator is the valve. Extending upward into the second cube is the motor control with its domelike housing. The third cube encloses the neck of the humidifier pan.

What shall we do with it? The first thing is to get it into perspective. Remember that we are dealing in masses which we must manipulate so that the entire housing will have a unified and coherent appearance. We draw an accurate mechanical perspective of the three cubes, as in Fig. 176*a*.

Unfortunately, these cubical shapes do not offer any pleasing possibilities in themselves. They are a miscellaneous lot, ill assorted and thoroughly uninteresting. They are little better

than a pile of building blocks left on the floor by little Willie before his nap. If we try to apply any of the rectangles which we discussed in Chap. X to the front or sides of these cubes, we shall be sadly disappointed. And we know that we cannot distort these shapes, because we are trying to enclose the controls inside as economically as possible. We should avoid, whenever possible, housing just "air."

There are other limitations. We must have a door 11 inches wide on the front so that the controls can be removed without taking off the entire housing. And the top cube must be inde-

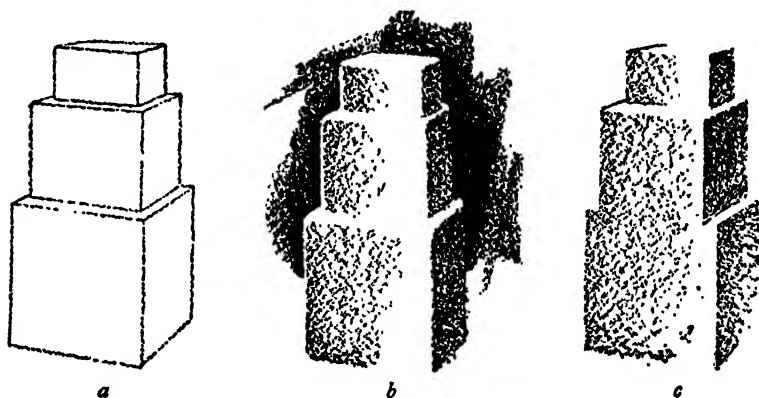


FIG. 176.

pendent of the rest so that the householder can remove it easily to fill the humidifier pan.

Our first step would be to place the perspective outline, shown in Fig. 176*a*, under a sheet of tracing paper and try various sketches over it. We must be careful, however, not to forget the shape and general character of the whole furnace while working on this component part. The furnace itself is an assembly of circular, cylindrical, or conical forms. Therefore it would be out of keeping to design the control housing principally of angular shapes. We might begin by rounding off the cubes themselves in an attempt to make one melt into the other, thereby mitigating their angularity (Fig. 176*b*).

Not so good. They are still so many boxes, one set on top of the other. Furthermore, we would have a high time trying to fit a door to those two lower cubes. They need some further manip-

ulation. What shall it be? Well, for one thing, we observe that the middle cube is only about an inch shallower than the bottom one, front to back. Surely we can take the liberty of allowing a little extra clearance for the motor control unit (Fig. 176*c*).

Distinctly better, you will admit. We have at least blended the two lower cubes, so that they become one shape. But it is not particularly pleasing; further treatment is necessary. Why not make that central vertical form into a dominant motive by pushing back the sides of the lower cube? We consult our prints

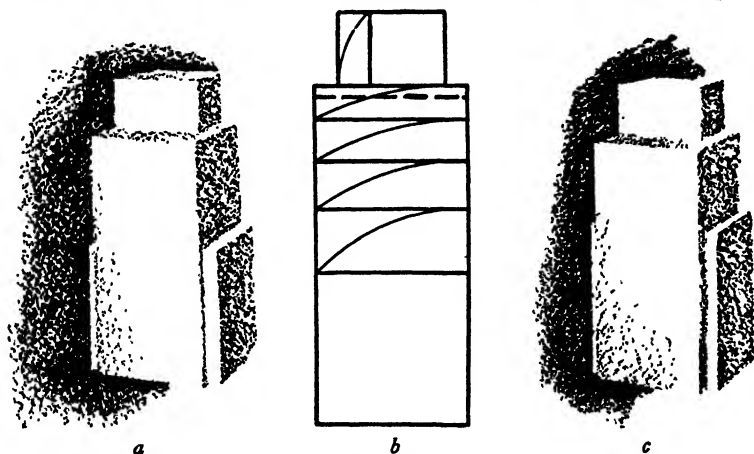


FIG. 177.

and find that there is no interference at this point; so the shape in Fig. 177*a* is developed.

It is now time that we checked these rectangles. The central panel is rather a long one, but upon laying it out in front view, we find that it falls only slightly short of being a No. V (see Chap. X). The smaller rectangle on top is somewhat less than a No. II. By extending the main panel until it becomes exactly a No. V, we find that we have reduced the height of the top rectangle so that it becomes exactly a No. II! (Fig. 177*b*.)

Again prints are checked for clearances, and nothing stands in our way. Thus we have reassured ourselves that the basic forms are dynamically respectable, and we have the feeling that we cannot go far wrong.

By pushing back the side panels, we have successfully met another problem, that is, we have provided a logical area for

the access door, which, to be of use, must extend almost the entire length and width of the housing. But the relative heights of the wings and the main body are not good—the wings now cut it about in half.

Again we take liberties for the sake of appearance and raise them to roughly three-fifths of the height of the vertical shaft (Fig. 177*c*). Then we introduce radii, cut some ventilating louvers, add handles to the door and to the removable humidifier-neck cover on top, apply an instruction plaque, and some decorative ribs. All this time we have done rough modeling in clay.

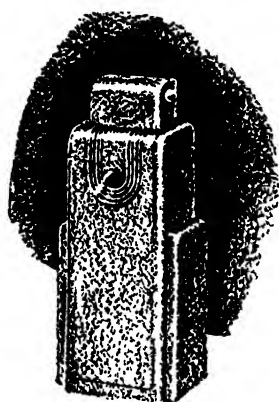


FIG. 178.

Now we build a wooden armature and make up a half-size clay study model. (See Chap. XVII.) Corrections in radii and placement of ribs are made and a set of model drawings prepared for the client, whose pattern shop constructs a full-sized wooden dummy and paints it to represent the finished article. Stock plastic handles are then obtained, and we supply a comprehensive of the instruction plaque, painted in tempera on silver-foil paper to represent the etched plaque which will be used in production. The final design will be seen in Fig. 178.

Our design has not been developed without regard to materials. The problem is this. The first production units will be of cast iron; if the resulting volume of sales justifies it, a switch to stampings will be made. Therefore we have had to keep both techniques in mind. Made in cast iron the design offers no particular problem. It requires no coring. The main housing can easily be pulled from the sand if the necessary draft is provided. To keep the sides together, tie rods are placed in three positions, which will be covered up by the door when it is closed. The door and the humidifier-neck housing are cast as separate parts.

There would be two possible ways to make the main body of the housing of stampings. It could be drawn in one piece, in about four successive operations, the front openings being then knocked out on piercing dies. This procedure, however, would be uneconomical. The draw would be rather deep and the tool

and die investment large. Furthermore, considerable waste would be involved because the openings account for almost the entire front of the housing, and the pierced-out pieces would not be large enough to use subsequently as blanks for the humidifier-neck cover.

A better way would be to design the tools in such manner that both sides of the housing would be stamped out in one piece on a rather shallow die, then cut them apart. Then a separate piece could be spot-welded to the flanges of the sides in order to form a bottom, and other cross strips could be spot-welded in at intervals to make the housing stiff. The door would then be formed separately, the ribs struck in with an embossing die, and the edges "hemmed" (turned back on themselves) for stiffness and to avoid a raw metal edge (see Fig. 179).

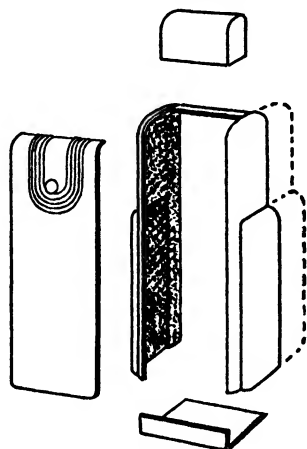


FIG. 179.

A NAPKIN DISPENSER

The next problem is not quite so cut and dried. It will give us more play for creative thinking, yet it will involve few manufacturing problems which are really complicated.

This time our imaginary client is a producer of paper products. One of his many lines is paper napkins for restaurants. The company wishes a new design for a dispenser to serve one napkin at a time.

Here is a problem that gives us plenty of leeway. The client wants something new—new in operation, new in materials, new in appearance. The item is noncompetitive, in the sense that it is not sold to the restaurant owner but given away with the first gross of packages of napkins. The client then gets his profit from re-orders in cartons containing a gross apiece. So the holder-dispenser is an ambassador of good will for the paper people. If it is attractive enough and different enough, they expect the restaurant owner to be a repeat customer for a long time. The manufacturer will sell additional holders at about cost—the more holders in use, the more sales of paper.

Therefore, he places few restrictions on the designer, except that the holder should cost not more than 75 cents, delivered. Quantity will be large, therefore the cost of dies or molds will not be a great problem. The client will package the napkins in quantities of 300, 500, or 1,000, whichever best fits the design. His machines can be adjusted to fold them in almost any way we specify. We could ask for little more in the way of freedom from limitations.

Investigating napkin dispensers already in use, we find that the most common variety is a stamped metal box, standing vertically, open front and back. Springs in the center feed napkins in both directions, keeping them pressed towards the outside,

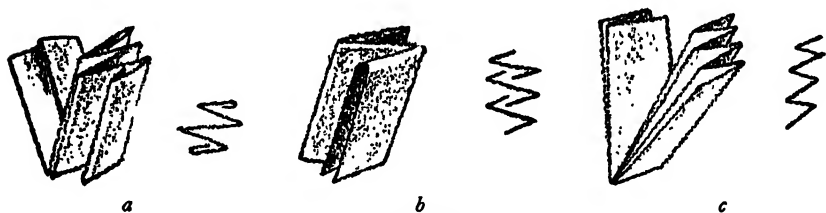


FIG. 180.

whence they are removed one at a time by means of a pleat in the center. This type of fold is shown in Fig. 180*a*. Sketches *b* and *c* show other methods of folding, either by interlocking (in which case the removal of one napkin starts another through a narrow slot), or by folding several times in one direction, then doubling once (for the open-type dispenser).

Our study of basic three-dimensional shapes (Chap. X) indicates that we shall probably have to confine ourselves to rectangular parallelepipeds or cylinders, or some combination of the two. On the face of it the sphere, the ellipsoid, the cone, and the pyramid show little promise.

We try a few sketches in the horizontal position first. Figure 181*a* combines a rectangular and a cylindrical form, using the conventional spring to feed the napkins up from below through a slot facing the customer; *b* utilizes a different fold, interlocking the napkins the long way, but a little experimenting proves that, when the napkins are packed tightly, their rough surfaces create so much friction that they are not easily drawn out. Furthermore,

we decide to abandon the entire horizontal idea because it takes up too much room on the counter or the table.

Returning to a vertical treatment we play first with the idea of accepting the conventional shape (square in plan view), with some modification of the top (Fig. 182*a*). Well enough, but not

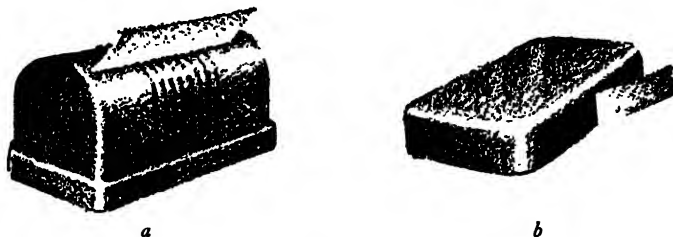


FIG. 181.

really new; the changes are only superficial. Next we stretch the square out sideways, making the plan view rectangular, and round two corners diagonally opposite (*b*). The remaining two sharp corners suggest placing two slots in these locations, permitting the free end of the napkins to issue from these slots. This treatment seems to invite the fingers to pull, but if the dispenser

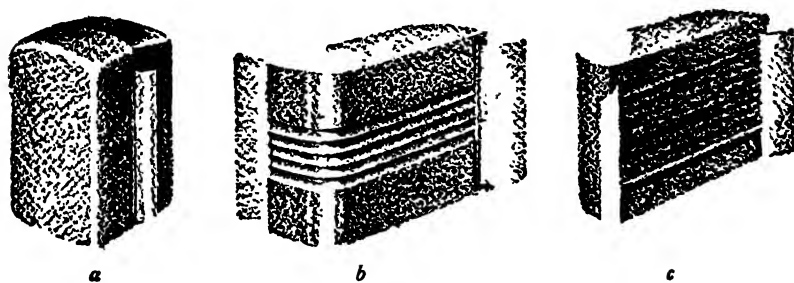


FIG. 182.

were placed against a wall in a "booth," it would leave one napkin inaccessible. Why not round off the two *back* corners and place the slots at the front corners, like *c*? This has possibilities, although for use on a lunch counter, it still takes up too much space. We shall put it on the shelf for further consideration.

Thus far we have shied away from the cylinder because paper napkins are usually made up in squarish packages, and circular forms seem to spell waste of space inside the container. However,

we should leave no stone unturned. The chief hurdle will be to find a way to package the napkins successfully. It occurs to us that perhaps the napkins can be folded in such a way that they can be packed vertically, in the narrow form, interlocked, and be served from a vertical slot. They would be packed surrounding a cardboard tube. We try various freehand diagrams on paper, but soon see that, at the inner edge, adjacent to the inner circle, they will be tightly packed but at the outside they will be loosely packed, as in Fig. 183*a*. However, the client has promised us that any reasonable folding scheme can be accomplished, but it must not be too complicated. Finally we arrive at scheme *b*.

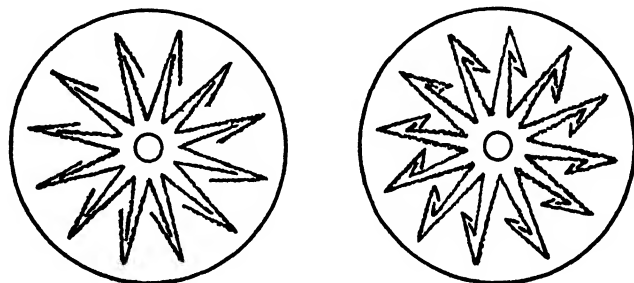


FIG. 183.

This calls for an interlocked arrangement, but the additional thicknesses of paper on the circumference will help take up the slack, and create greater thickness at the point where we need it. We begin folding sample napkins in this manner and the results are encouraging.

The next problem is that of feeding the napkins forward with constant pressure so that as soon as one is drawn out, another will present itself at the slot.

We must therefore turn our attention to the matter of assembly and materials. We have felt all along that some light-colored plastic will be the proper material for the holder. The question of finish will thus be eliminated, for the color in the plastic goes all the way through. It is light and will not shatter easily, and a rubber suction cup will fasten it in place. A die casting might be satisfactory but a bit heavy. Glass has obvious disadvantages.

The "chassis" on which we mount the tube-shaped package of napkins—the hidden parts inside—need not be a plastic, for it will not show. Light-gauge metals will do just as well. We shall have to provide some kind of plate at the bottom which is easily removed for refilling; then a tube over which to thread the package of napkins; and then a plate actuated by a spring which will press the napkins in a circular direction and feed them towards the slot.

Our first crude conception of this assembly is shown in Fig. 184.

It would make this narrative unnecessarily detailed to describe the final way in which this simple mechanism might be worked out.

Our client takes up the idea, makes a set of drawings, and builds an experimental device. After two or three attempts, a satisfactory

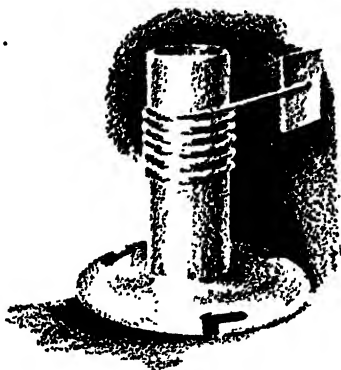


FIG. 184.

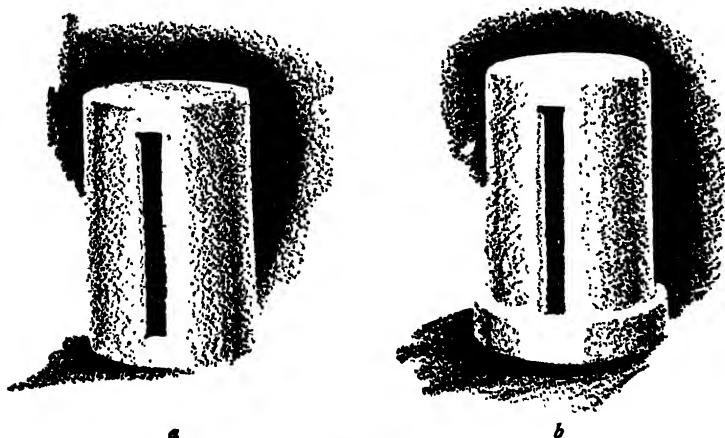


FIG. 185.

solution is reached, and the principle of dispensing napkins from a cylindrical container is satisfactorily established.

Our next and *last* job (the one which the public and often the client believe to be our first and *only* job) is appearance. The

matter of appearance, the superficial outside dress, can now be solved in many different ways. Each solution, however, must be practical. Since we have decided on a synthetic plastic, we must

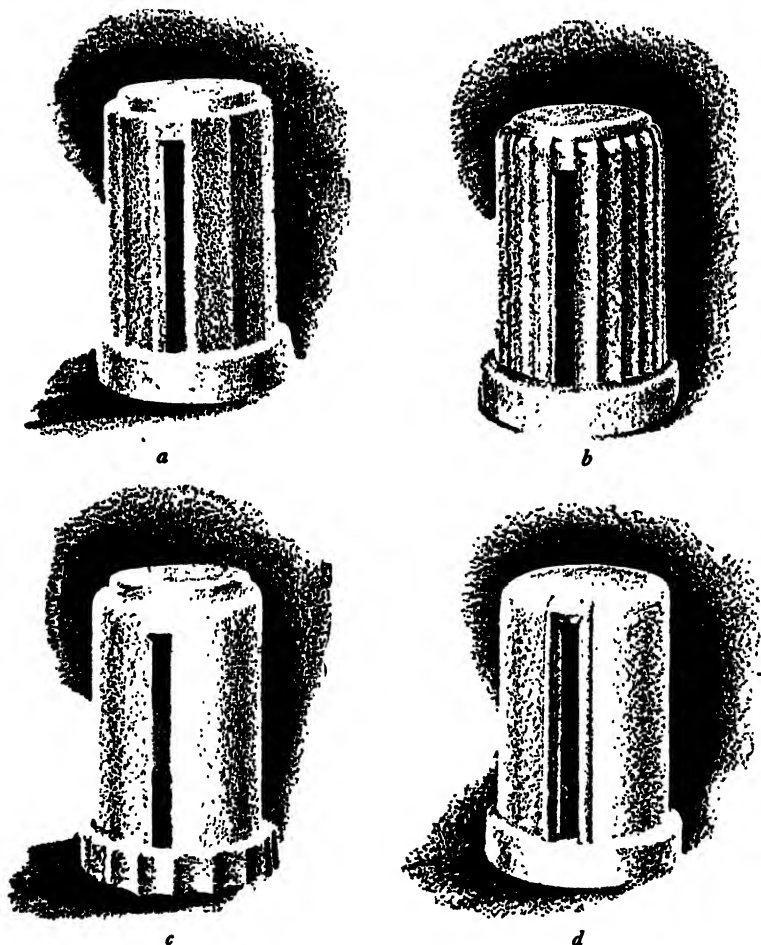


FIG. 186.

make the molding job as simple as possible. It would be splendid if we could mold the housing in one piece by simple compression molding: a straight stroke of the force into the cavity. But we now have a cylinder which must have an open slot for almost

its entire height, and we seem to have jockeyed ourselves into a position where a cam-operated mold with a loose piece will be required to form the slot, as in Fig. 185*a*.

After a little study, however, we hit upon the idea of offsetting the base. This enables us to design the force part of the mold with a long rib protruding from its side, slightly greater than the thickness of section of the material, which in this case will be about $\frac{3}{32}$ inch. A corresponding groove will be cut in the cavity, so that the rib fits into it like a keyway, with clearance of only a few thousandths of an inch. This creates a thin fin the length of the slot which is later broken away. The offset base, *b*, further solves the problem of a ledge or rim against which to seat the metal disk and provides a place for metal stud inserts to slip into the bayonet slots in the disk.

Decorative treatment alone remains (Fig. 186). We try facets (*a*), flutes (*b*), a fluted base (*c*), and finally keep the surfaces perfectly plain (*d*). (When in doubt, leave it out!) Plastics need very little decoration to make them telling, because color and surface luster do your designing for you. In sketch *d* we have put a border around the slot. This was done for two good reasons: (1) because it accents the opening and (2) because it helps to disguise the slight roughness resulting from breaking away the fin.

We show perspective sketches in colored pastels of these four designs to our client. Fortunately he agrees with us that the last is the best. A plaster dummy model is made to study appearance, a few slight changes in curvature of the dome on top are made, and the final mechanical drawings are prepared from which the molder will design his molds.

XXVII · Case Histories

THREE CASE histories are here presented so that the student may see how the procedures described in this book were carried out in products and machines actually on the market. The three general groups of items coming within the scope of this volume—consumer products, commercial equipment, and durable goods—are represented respectively by a sled, a meat grinder, and a four-pocket dough divider.

To conserve space these histories are condensed as much as is compatible with clearness. The quotations from letters, memos, and telegrams are abstracted from our files. My organization will be referred to as “VDA” and the clients by appropriate initials. Frequent reference should be made to the half-tone illustrations, especially in studying the dough divider.

CONSUMER PRODUCTS

This is by far the largest group of items claiming the industrial designer's attention. It includes thousands of products from lipsticks and frying pans to bicycles and refrigerators. It was of course the first field of design-for-appearance to be exploited. Although commercial machines soon received much attention, unit sales in comparison with consumer goods would probably be in the ratio of 1 to 100.

The consumer product described herewith was chosen because it proved to be a “natural”—one of those basic designs that influenced the entire industry. Mechanical and design patents were issued. Several competitors imitated the design so closely that the client, after threatening suits for infringement, is collecting royalties from several sources. Other sled manufacturers too have tried, with more or less success, to imitate its general lines without incurring the risk of prosecution.

A Streamlined Sled

CLIENT: The American National Company, large manufacturers of wheel goods, playground equipment, etc. Three plants in Toledo, Ohio, one in Perrysburg, Ohio. Sales (effected by company salesmen throughout the country and by manufacturers' representatives) are to department stores, furniture houses, sporting goods shops, and chains.

BASIS OF REMUNERATION: Retainer fee.

PLANT EQUIPMENT: Large stamping presses, punch presses, power brakes, and bulldozers; wood-working equipment (including a wood-printing machine); spray booths and dipping tanks; rotary shears, tool shop, etc. No foundry.

THE PROBLEM: The first fully streamlined child's vehicle was a small steel wagon produced by Metalcraft, Inc., of St. Louis. American National brought out the second, the "Skippy Scooter," designed by J. G. Rideout, then a partner in our organization. Both were sensational sales successes and started the industry on its way towards streamlining. Our client determined to cash in on this prestige and, with their large resources and sales outlets, build vehicles which, because of the die expense and size of presses required, could not easily be imitated by smaller competitors. In the next few years we designed for them a steady stream of streamlined coaster wagons, Irish mails, tot bikes, velocipedes, juvenile automobiles, etc., etc. We considered this borrowed streamlining entirely legitimate for reasons given in Chap. XII.

Until the Sno-Plane was introduced, the client had built a small line of conventional sleds in order to "have them in the line." They were indistinguishable from those of many competitors, except for the brand name printed on the centerboard.

The original assignment, as outlined by the client, was to "dress up" the current line of sleds with color, better printing, altered shapes of slats, etc. Nothing radical.

PROCEDURE: The first meeting was held at the client's plant April 3. Mr. D., vice-president in charge of sales, Mr. S., sales manager of the "Skippy" line, and the designers were present.

Memo: . . . Discussion turned to the sled line. Mr. D. said the company must do something about sleds or get out of the sled business. Mr. S. concurred, saying price competition was now so acute that there was no margin

in it unless you had either a novelty or the cheapest sled on the market. Labor rates here make the latter impossible . . . VDA instructed to study the present line carefully and begin thinking it over. . . . No hurry, since sleds would not be introduced until the Toy Fair in New York the following year. . . .

Apr. 10. VDA visited the wood-working plant to inspect available equipment, with especial attention to wood-printing machine. Because of rush of more immediate problems for this client, actual sketching was not begun until May 3 but was pushed steadily after that.

May 3 to 5. Various jointed, or double-truck, sleds (bobsled principle) were first attempted in rough sketch form. One of these

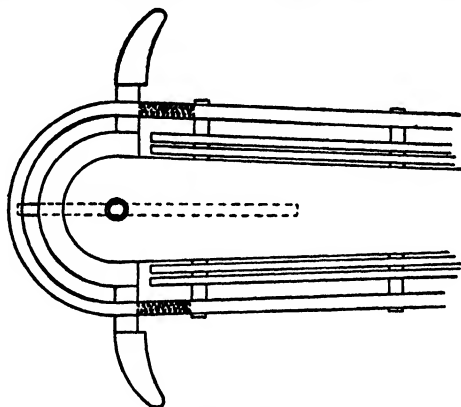


FIG. 187.

got as far as scaled drawings, proved too difficult to make good looking.

May 6. The germ of the Sno-Plane was put on paper. After the first tentative sketches, the idea unfolded rapidly: make a sled *steer like a velocipede* by means of a separate center runner; the side runners were to be fixed, but break from contact with the ground *farther to the rear* than the conventional sled. Then we would mount this separate center runner, shaped like a skate, to the under side of a turntable, and fix the turntable to the under side of the centerboard by means of a king bolt. A steering cross-bar of strap steel, with molded rubber grips, was to pass through slots in the tubular front end, with concealed coiled springs to return the center runner automatically to the straight forward position, as in Fig. 187.

May 10. Meeting at the plant, with the same group present.

Memo. . . . After other business was discussed, Mr. D. asked what progress was being made on the sled. VDA said they believed a good idea had been developed, but it was rather radical. Would like to develop sketches and mechanical drawings further to check the principle. . . .

May 6 to 29. As work progressed, it was felt that, contrary to usual procedure, no sketches should be shown until all mechanical features had been worked out. We realized that, if turned over to the client's engineering department in the form of rough sketches, they might feel it was too radical a departure from accepted practice. As perspective drawings of the under side of the front end were made to visualize the steering principle, and innumerable treatments sketched of the top view, a draftsman was concurrently making half-scale drawings on detail paper of the shape



FIG. 188.

of the top, the arrangement of slats, shape of cross members, sweep of runners, curve of tubing, etc.

The worst problem was the "knees" or metal supports which fasten the runners of a sled to the cross members. The general scheme called for a cross between a tapered surfboard and a toboggan. The tapered effect was necessary to obtain the best appearance; but the runners of a sled must be absolutely parallel. Furthermore, in side view, it was desired to make the knees quite different from the conventional pyramidal knee used by all other sled manufacturers (see Fig. 188*a*). In section the new knee was to be blunt in front and tapered behind, like an airplane wing-strut. Then to get the necessary contact with the runner, it was to trail out in a long triangle behind, the broad surface of this triangle to be punched with round holes to save weight and to resemble the duralumin framing used in dirigibles, pictures of which most children are familiar with (see Fig. 188*b*).

However, it was also desirable for appearance that the sled should slope *downward* toward the rear. Therefore, the knees would have to be made in two different heights. The construction of these knees and the method of fastening them to runners and cross braces was finally worked out so that assembly could be made without any special equipment.

Most sled bodies consist of side rails in the form of round doweling, two or three cross members to which these are bolted, and three flat slats of equal width running lengthwise between the side rails. To give variety to this monotonous arrangement, we specified a wide centerboard for accent, flanked by two narrow rails on each side, resembling the half-rounds of a toboggan (see Chap. IX and Plate 32). The forward end of the centerboard was rounded to repeat or "recall" the shape of the chromium tubular nose and of the turntable to which the skatelike steering runner was fastened. The centerboard was tapered rearwards parallel to the rails, overhanging the end, the other half-rounds being cut to different lengths to conform and give a finished appearance.

The forward ends of the side-rail doweling were turned down and the open ends of the U-shaped tubular nosepiece fitted snugly over them and fastened with rivets.

May 26. Side and top views, half size, were traced down on Bristol board, and a careful airbrush drawing in black and red was begun (Plate 32).

May 29. Meeting at the plant, same group present.

Memo: . . . The sled presentation was made and was enthusiastically received in regard to appearance. . . . Price was discussed, and VDA said it would be a de luxe sled, but believed that cheaper models with similar general appearance could be worked out later. . . . VDA to proceed with finished drawings.

June 1 to 6. From layouts on detail paper and dimensioned details already worked out tentatively, a full set of mechanical drawings was quickly produced: one assembly, 19 sheets of details, and a bill of materials. Prints were made and a set turned over to the client's experimental department.

Due to other more urgent matters, construction of the first experimental sled was postponed until later in the summer. When completed, the weight was excessive although this was

partly due to the heavy brazing on certain handmade parts. The first snow was not until late in October. First tests were disappointing. The sled was slow in action. It was found, however, that the runners were not at all parallel. This was corrected, but steering was still not satisfactory—the center runner seemed to exert a braking action. This was corrected by curving upward the trailing end of the steering runner, and finally the sled was made to steer easily. In one test it shot out onto a frozen pond and was made to turn a complete half circle returning in the direction from which it started.

Production began. Rubber grips were molded and attached to the steering bar with brass grommets. A few sleds were made and sold for Christmas trade, enough for a test. The steering bars bent easily; weight of the bar was increased. Some sleds were returned because they would not steer at all. This proved usually to be due to the center runner not extending *below* the plane of the side runners, as specified. (See Plate 32, side view on the air-brush drawing.)

First general introduction to the trade was made the following April at the Toy Fair in New York.

RESULTS: It must be admitted that the special steering feature of this sled was not a great success. If precision manufacture were the rule in sled factories, and all units could have been turned out to rigid specifications, little trouble would have been experienced after the “bugs” had been eliminated. But the necessary tolerances, in a product made of a combination of wood, tubing, and cold-rolled steel, were difficult to maintain.

After a season, the Sno-Plane was modified, keeping the same general appearance, but returning to the runner-warping principle of the old sleds, and using a wooden steering bar instead of metal. This reduced weight and selling price, although the sled still remained fairly high priced as sleds go.

Its success on style, however, was phenomenal. It proved a “calling card” for salesmen and increased sales for the client in many other unrelated items. It opened the door for the regular sled line to one of the largest mail-order houses, where our client had never been able to sell sleds of any kind before. Imitations flooded the market. It became a style leader, although some of the original features which made it “different” were abandoned.

COMMERCIAL EQUIPMENT

Modernization of consumer goods began to make the public conscious of the appearance of equipment they found in retail stores, restaurants, offices, and in public places such as railway stations and subways. A department store, for instance, carrying up-to-the minute merchandise on the sales floor, could ill afford to use antiquated cash registers. Although subnormal business conditions were reflected more rapidly in the modernization of consumer merchandise, it was not long before makers of commercial items also found redesign a reliable stimulus to sales. A steady stream of modern drinking fountains, gasoline pumps, vending machines, office equipment, coffee mills, penny-in-the-slot scales, and soda-fountain fixtures began to appear.

In general, the smaller volume and greater length of life of most of this type of equipment meant that less money could be spent for its rehabilitation. The ratio of commercial sales to capital goods, however, would be about 100 to 1 again.

A Meat Grinder for Retail Food Stores

CLIENT: Enterprise Manufacturing Company of Pennsylvania. Plant in Philadelphia. Originators of both the hand- and electrically-operated meat chopper. Sales are handled in several territories by The Toledo Scale Company, in connection with their line of weighing equipment sold to the same outlets.

BASIS OF REMUNERATION: Lump sum, plus allowance for drafting, rendering, models, and traveling expense.

PLANT EQUIPMENT: Many special machines for making cutting knives, squeeze plates, etc. Also gear cutting equipment. Large iron foundry, but some castings are bought outside. Tin-plating equipment and facilities for grinding, filling, and finishing castings.

THE PROBLEM: The first meat grinder we designed for Enterprise consisted of a machine made to harmonize in design with a series of Toledo scales. To accomplish this an unfinished cast-iron machine was housed in a white Plaskon cover similar to the scale in treatment. The result was a rather high priced, de luxe grinder. We were then commissioned to convert the standard cast-iron machine, painted in bright red with gold striping, into a

more modern form, to sell for at least the same price as the standard. Emphasis was to be placed on clean lines, fine finish, and ease of cleaning.

Essentially a meat grinder consists of a motor, a gear case with reduction gears, a base, and a detachable grinding head. To operate the machine the butcher flips the switch and presses meat into the vertical "bowl" against a feed screw; he often exerts a great deal of pressure with a wooden or metal stomper. Since machines are rarely bolted to the counter, a heavy footing, carefully adjusted to prevent tipping forward, is required. Little change was called for in the cutting group (this had been "touched up" for the de luxe machine previously and a new style of stamped tray designed) since it is severely functional.

PROCEDURE: General requirements were discussed on Feb. 12 at Toledo with executives of Enterprise and Toledo Scale companies, and confirmed with our fee quotation in a letter from VDA to the general manager of Enterprise on Feb. 13. Authorization to proceed was received Feb. 25.

Feb. 27. A sample grinder of the old type was torn down and studied. Rough sketches were begun.

Mar. 1. Letter from VDA to Blank Electric Corp., Chicago.

. . . We are starting to redesign a meat grinder for Enterprise. . . . Their general manager suggests that we write you so that you can keep in touch during this development. . . . Although we have scarcely begun, the design tentatively in mind contemplates some changes in the treatment of the endbell and the possible use of a stamping which would slide over the motor and cover it entirely. . . . To work out these changes intelligently, we should have some authorized representative of your company call on us here and check the changes we want to make so that they can be done as inexpensively as possible. . . .

Mar. 2 to 18. It had become apparent that more rapid progress could be made by working directly in clay. A clearance layout was prepared. From this we constructed a wooden armature, consisting of (1) a base, roughly oval in shape and considerably under size to permit wide variation of treatment with the clay; (2) a postlike support; and (3) a solid cylinder of wood in a horizontal position. The cylinder was bored out at the front end to receive the metal cutting group and weighted with lead at the other to counterbalance the heavy metal parts. The wooden cylinder was made to the actual diameter of the motor plus $\frac{1}{2}$

inch, so that the resulting surface would represent the actual sheet-metal cover which we planned to place over the entire motor. This part of the armature was then painted gray-green to match the modeling clay, since no additional clay would be added for part of its length.

Mar. 6. Letter from VDA to Enterprise.

. . . We are making good progress with the grinder design. It is difficult to show adequately in sketches, therefore we are modeling it in clay with the idea of bringing you the full-size model. . . . We should have the main features fairly well worked out in another two weeks, at which time we shall write for an appointment. . . .

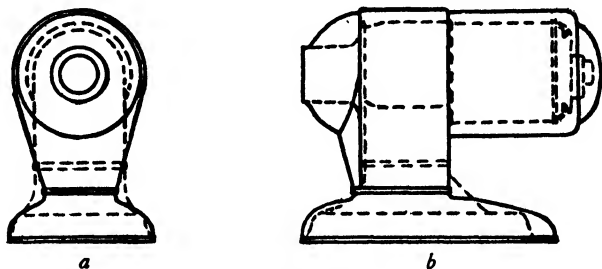


FIG. 189.

The old machine had a base from which rose pedestals, one supporting the gear case, the other the motor. If we had followed this general scheme, styling would have been reduced to smoothing out and simplifying these clumsy forms. We decided to combine the pedestals, substituting a single thick pedestal which would house gears, motor coupling, and oil sump in a single casting. This required widening the column considerably and, in order not to make a break at an awkward place, extending it downward as far as possible before reaching the joint with the base. Figure 189*a* and *b* shows the new outlines superimposed on the old dotted lines. The front view shows how the pedestal was tapered inward to provide more graceful lines.

Mar. 29. Meeting at Philadelphia. Executives, engineers, and designers present.

Memo: A clay model, sprayed with aluminum paint was presented. . . . General appearance commended. . . . However, two questions arose: (1) size of base; (2) type of motor. . . . The base was not believed long enough in front to prevent tipping when operator applied pressure in the bowl with a stomper. VDA said that a much longer base would spoil the sweeping lines.

. . . Recent studies by Enterprise indicate that a capacitor-type motor might have to be used. . . . VDA said that the addition of a capacitor would make the present design impossible; that it would have to be redesigned entirely. . . . Mr. R. (engineer) will contact motor manufacturers again to obtain information on standard brush-lifting type of motor which could be totally enclosed, as indicated in the design. VDA pointed out that with this design the stamped motor cover could be attached and drawn tight with a single screw in the end, and that all other fastenings would be concealed. . . . Discussion about the oil level gauge. . . . It was decided that the gooseneck type was not necessary, and that a flush plug could be used.

. . .

Apr. 3 to 20. Investigation of motors caused considerable delay. Finally a motor was found which filled the bill, but it was nearly two inches longer, also larger in diameter. Our clay model, returned to Toledo, had to be made all over again. The larger motor provided additional counterweighting against tipping, but considerable enlargement of the base now became absolutely necessary for appearance. On Apr. 12 a new clay model was finished, mechanical drawings were made the following two days, giving all clearances, and forwarded to Philadelphia. These were approved with a few minor changes. The clay model was then cast in plaster, sanded, and painted. A wooden core was imbedded in the front end of the plaster body to receive the cutting group, and a careful comprehensive of the identification and data plate made up on silver foil and cemented to the tail of the base. A toggle switch was placed in the center of the name plate—an example of one plate serving at once as identification, data, and switch plate (see Chap. XXII).

However, a long delay occurred in working out the adaptation of the motor, and the model was not forwarded to Philadelphia until late in August.

Aug. 23. Letter from VDA to Enterprise.

. . . As per our telegram we are shipping you tonight one crate containing the model of the revised cast-iron meat grinder. . . . We hope you will be pleased with this model as it has been built with great care. The entire machine has been redesigned, and we found we had to make many slight but important modifications to get just the right proportions. . . . We have finished the model as before with a $\frac{3}{8}$ -inch black stripe around the base to represent the rubber pad. The note of black is picked up again in the metal switch plate which gives the name of the company and all data. We don't want to put any other striping or marking on the machine. . . .

Regarding the switch plate, it will have to be *formed* slightly to conform to the base after being etched and plated. . . . Please note that we have placed a bead around the lower part of the main housing so that if there are any discrepancies in the castings, they will not be noticed. This will also serve to conceal the edge of the switch plate. . . . We believe that the model is accurate enough so that it can be used by your pattern shop in making experimental pattern equipment. . . .

Aug. 28. Letter from Enterprise to VDA.

. . . I have before me your letter of the 23rd, and the model which has now come to hand, and I cannot say that I like it quite as well as your first design. It seems to me that the section which carries the motor (the pedestal or column) is too large for the grinding head and the base. . . .

Aug. 29. Letter from VDA to Enterprise.

. . . Regarding the size of the center column, we made it even narrower than the way your engineers laid it out. On the other hand it cannot be as narrow as our first model because it is supporting a much bulkier motor. . . . The diameter of the former motor was $6\frac{7}{8}$ inches. This one, with the slip-cover type of housing over it, comes to $7\frac{3}{8}$ inches and it is 2 inches longer. We were cautioned to keep the center line of the motor and feed worm the same distance from the table, consequently this is bound to make the column shorter and squattier in general appearance. . . . To compensate for this we have made the base casting much more massive in all directions. . . . It is perfectly possible to remove some of the supporting column at its back face as there is more room inside than absolutely necessary. However, we would hesitate to do this because it would look weak with the big overhang of the motor in the back. . . .

Compared with the first model, photographs of which we had sent them, the enlarged design was bound to look heavier because it *was* heavier. The general theme, however, had been preserved, and as soon as they became accustomed to the greater apparent weight, the design was accepted as final. Detailed drawings were made, patterns built, and a complete operating model was presented in Toledo at a meeting of executives of Enterprise and Toledo Scale.

Memo: . . . Grinder model was displayed and received with enthusiasm. . . . The perfect finish of the iron castings was especially commended, being equally as smooth as the drawn steel motor cover. . . . Scale Company executives asked if this could be maintained in production and Enterprise stated that it could. . . .

RESULTS: Weight reduced 40 pounds. Cost reduced about 2 per cent. Sales increased 22 per cent in the first year after introduction.

DURABLE GOODS

Appearance design as an aid to selling products to the ultimate consumer is now an established part of the scheme of things. But what about machines bought by industry? What about stamping presses and screw machines and grinders and lathes? What about heat-treating furnaces and printing presses, tabulators and milk-bottling machinery?

Most machines perform a single operation which may be defined as one step in the process of manufacture from raw materials to the consumer. Each machine is just one of the tools of production, unseen and unsung as far as the user of the ultimate product is concerned. When you eat potatoes you never give a thought to the plow that turned the ground—and if you did would you care whether or not it was a good-looking plow?

The consumer does not care much about the machines that make the products he buys. But men in the plants where the products are made—plant superintendents, shop foremen, even workmen—are beginning to care. The shop looks better, is easier to clean. The workman is happier at his work, proud of his machinery. Depreciation is reduced if exposed parts are enclosed, streamlined.

The farmer is beginning to demand style. Tractors are being streamlined; harrows, corn pickers, even manure spreaders* are receiving the attention of the professional designer.

In durable goods, performance always comes first. But given two machines of equal performance and equal price, which will the plant manager buy, the haphazard one or the clean-cut one? Other factors being equal, such as his personal relations with the representatives of the various suppliers or the service reputation of the suppliers, he will be swayed to some extent by neat and smooth appearance.

The problems of the designer in styling durable goods are often much more exacting than in consumer or commercial

* A streamlined manure spreader was introduced by the Oliver Plow Company in 1939.

equipment. They are usually more complicated, and many operating parts may have to be exposed. The motor may be one of a score of different makes, specified by the purchaser. Volume of production is small, although the price per machine may be anywhere from \$1,000 to \$100,000. The machinery plant often does not have even one completely assembled machine on the floor; they are shipped as soon as completed and tested. You may have to inspect a finished machine in some other manufacturer's plant. There are no annual models, but engineering changes are being made constantly, and it is sometimes difficult to obtain even an up-to-date set of drawings.

There is one advantage you may have in working on this type of equipment: schedules for completion of the design seldom include any particular dead line, and you are usually not unduly rushed in studying the problem. Costs do not hamper you quite as much as in consumer merchandise. Adding a few dollars to prime cost here and there on a machine that sells for \$10,000 is not so serious as adding five cents to the cost of an appliance which sells for \$25.

The success of a machinery project, as indeed of all industrial-design problems, depends on the closest kind of cooperation between designers and engineers. Often the designer is able to make some suggestion that improves accessibility or gives greater convenience for the operator. The chief objectives are: (1) to make the external design reflect and express as far as possible the function of the machine; (2) to conceal all mechanical parts that can reasonably be enclosed; (3) to arrange and simplify controls for maximum accessibility and easy "reading"; (4) to evolve some theme of treatment which can be carried throughout all of that maker's machines, and which will act as a trade-mark, even before the name of the maker can be read (see Plate 21).

The example given below has been chosen because it is a rather complicated machine, and because we were permitted considerable leeway in all matters having to do with appearance.

A Four-pocket Dough Divider .

CLIENT: Baker Perkins, Inc., well-known manufacturers of bakery machinery. Plants at Saginaw, Mich., Peterborough, England, and Melbourne, Australia. Associated with similar firms

in Paris, France, and Stuttgart, Germany. The company also makes a line of equipment for the chemical industries. It has two subsidiary plants making other types of food machinery.

BASIS OF REMUNERATION: Retainer fee, plus additional monthly allowance for drafting, rendering, and models.

PLANT EQUIPMENT: The Saginaw plant includes a machine shop and a steel fabrication shop with heavy rolls, shears, power brakes, radius formers, and welding equipment capable of handling steel plate up to $\frac{1}{2}$ inch in thickness. No stamping equipment. Also a well-equipped modern foundry handling iron, brass, etc.

THE PROBLEM: The modern commercial bakery is equipped to produce breadstuffs from the time the raw ingredients are measured into the mixer to the time the finished loaves are loaded on delivery trucks, without being touched by the human hand. The machines required in their proper order are: ingredient-handling equipment, mixer, divider, rounder, proofer, molder, final proofer, bake oven, cooler, slicer, and wrapper.

The function of the divider is to measure, by volume, enough dough to form an individual loaf. Dividers are made with 2, 3, 4, 6, and 8 pockets, each separating out from the mass of dough in the hopper a corresponding number of equal-sized dough pieces at one stroke of the machine. Machines are adjustable for size of loaf. Briefly, the dough mass is fed by gravity into the machine, a spring-loaded ram pushes a portion of it into two (or more) metal pockets in a reciprocating head. The head moves down and cuts them off, an ejector pushes them out and drops them on a moving belt. They are dusted with flour and conveyed to the next machine (for the rounding operation).

As with most modern machinery performing a highly specialized operation, proper performance must be paramount. Food machinery manufacturers, however, have always been somewhat conscious of appearance, proved by the fact that most machines are painted white. Sanitation is important and many modern bakeries have "visiting days," and in many cases the machinery is placed behind windows to attract the public. No concerted effort, however, had been made toward systematic styling until Baker Perkins instituted the program of which this 4-pocket divider was a part.

No time limit was placed on the development. Re-engineering and improvement of operation were to proceed concurrently with appearance design. Three machines were being redesigned at the same time: an 800-pound mixer (see Plate 11 for model), a 4-pocket divider, and a 51-inch rounder. The three machines were to be given a similar theme to provide "family resemblance." The following day-by-day case history omits mention of all machines except the divider.

PROCEDURE: *Mar. 3 to 4.* VDA spent two days at the Saginaw plant with Mr. P., the vice-president and general manager, and Mr. S., the chief experimental engineer of the bakery machine division.

Memo: . . . There was general discussion of the bakery machine line as now constructed. Welded steel replaced cast iron for frames and housings about three years ago. . . . VDA were taken on a tour of the plant. Mr. S. explained the operation of the divider and blueprints were studied. Secured a complete set of prints and several photographs. . . . VDA to submit first sketches of general themes in rough form for discussion at a future meeting. . . . A "laboratory" bakery in Saginaw was visited to observe the operation of machines in actual use. . . .

Mar. 5. Visit by VDA to a bakery in Toledo for further study of machines in operation. Operators were questioned on convenience, cleanability, etc. (see Plate 14, No. 1).

Mar. 6 et seq. Photographs of two views, front and rear three-quarters (see Plate 14, No. 2) were enlarged by photostat, outlines traced, and many rough visualizations made. On Mar. 12 the first rough sketch showing promise was produced (Plate 14, No. 3). A rough mechanical layout to establish clearances was made the same day. The sketch showed a half-cylindrical form at the rear and a semicylindrical housing to cover the divider-box mechanism, the housing to move up and down with the action of the machine. Ventilating louvers were shown at the bottom and sides although later we suggested using a recessed base, which provided sufficient ventilation and entirely eliminated the louvers.

Mar. 15. Dimensioned layout—plan, elevation, and side view—was prepared.

Mar. 16 to 21. An armature was built and a clay study model begun. This was prepared in segments to show both circular and square treatments of the rear (Plate 14, No. 4).

Apr. 2. Meeting held in Toledo to discuss first sketches and study model. Mr. S., Mr. R. (draftsman), and the designers were present.

Memo: The study model was discussed, but doubt expressed about the cylindrical treatment of the rear end. VDA to work out minor forms further. . . . Possibility was mentioned of using chains instead of gears for conveyor power. This might permit shallower gear boxes or guards. . . . Pulling in of ejector mechanism, now under consideration, will make possible a shorter machine. . . . VDA to present progress of the divider design at Saginaw, the week of Apr. 18.

Apr. 8. Letter from BP to VDA.

We wish to acknowledge your telegram asking for a plan view of the divider with basic dimensions. . . . We assume that you want to know the limitations in the width of the frame as controlled by the mechanical arrangement at the various shafts. This is essentially the same, and we have marked on the print the basic dimensions. . . . We wish to repeat that we felt the rounded rear end does not harmonize very well with the mixer design you prepared, besides requiring more floor space. I find here a decided prejudice against the cylindrical scheme you propose. I realize that this is early in the game and your thoughts may change. . . .

Apr. 9. Letter from VDA to BP.

We are working on another model of the divider. . . . We rather agree with you that the resemblance between the mixer and divider is not strong enough, although in certain details we can give a family resemblance even when the main forms are quite different in character. . . .

Apr. 9 to 19. The clay model was revised and photographed. From the photos two perspective sketches in color were prepared of three-quarter front and rear views (Plate 14, No. 5). Three new rear-end treatments were prepared and arranged to fit the main body of the model with dowel pins so they could be shown interchangeably.

Apr. 21. Meeting at Saginaw. Engineers and designers present.

Memo: VDA presented sketches and models. . . . Generally well received. . . . Discussion centered on the following: *Length*—add a few inches to the front to enclose speed control and adjustment. *Width*—5 inches to be added to frame width to accommodate new type of variable speed drive. *Height*—no basic change. *Shaft ends*—if use of pillow block or some other means of placing and securing stationary rear shaft from inside proves satisfactory, the frame at this point will conceal shaft ends. . . . Probable construction changes: ejector box guides to be cast and secured from inside of

steel frame; this made possible partly by widening the frame. VDA to hold up design on this arrangement until BP is able to develop it on paper. . . . Chain and sprocket drive for conveyor belt would reduce size of the gear box. . . . VDA to consider the ejector box from the safety angle, possibly enclosing entire box so that all up-and-down movement takes place *inside*. . . . *Dough feeder adjustment*—Mr. S. pointed out that the vertical-type of door as used on some six-pocket machines had received few service calls and greater acceptance in the field. VDA to consider possibilities of changing to this type of door. . . . New wider frame will permit duster boxes to be built partly on the inside. . . . This will make for better design since it will be less conspicuous. . . . *Color*—white; small areas of BP blue in place of red as shown in VDA sketches. Stainless steel parts to be lacquered. VDA have new metal lacquer in mind and will locate samples.

Apr. 22 to May 7. Further sketches were developed with a stationary housing for the ejector box. An alternate design, simplifying the entire housing and completely enclosing one end of the conveyor was prepared in colored chalk perspective.

May 11. Telegram from VDA to BP.

Have new sketches on divider but cannot proceed further until we see you. . . .

May 12. Letter from BP to VDA.

One of our draftsmen has done some preliminary layout work on the divider and has sketched out some interesting structural details. . . . Can we meet May 17?. . . .

May 17. Meeting in Toledo. Mr. S., Mr. R., and the designers present.

Memo: VDA presented new divider sketches with the mechanism almost entirely covered (Plate 15, No. 6). It was considered to be over-simple. As discussion developed sketches were made, one of which seemed to be basically the correct form from manufacturing, appearance, and operation standpoints. This sketch really was a combination of two previous VDA sketches. This new scheme is to be rendered in perspective by VDA, incorporating the new enclosed duster and gear boxes as developed by BP. . . . Mr. S. believes they would be able to build a stationary dough-box adjusting wheel in a panel at front of the machine. In the same panel could be housed the speed control, gauges, and the start-and-stop buttons. . . . A swing-gate dough door will be used and VDA will try to improve the appearance. Step plate for the operator to get at the hopper must be shown on new sketches.

May 18 to 25. New sketches were made and details of panels and control wheels worked out. A perspective color sketch was prepared (Plate 15, No. 7).

May 26. Meeting at Saginaw. Engineers and designers present.

Memo: VDA presented new sketch of divider. During the discussion it was decided to continue metal bands at the side of machine on over the conveyor roll to the front. . . . Because of the dough-box control shaft at front of the machine, it was decided to build two duster trays instead of one. These will be on angular planes and would pull out from the sides. These pans would be pitched from the center of machine down to the sides. . . . Louvers eliminated, and set-back base approved. Ventilation to be supplied through the openings thus provided. . . . Pan of the secondary conveyor belt might be made wider and deeper to enclose the roll ends and mechanism. . . . Steps will be eliminated from sides and a disappearing step incorporated at the front, near controls. Handle near the hopper is out. VDA to send perspective outline sketch to Mr. S. and photostat of same to Mr. B. (president) in New York. . . . VDA to proceed with quarter-size model before next meeting. Photos to be made of models for Mr. B.

June 2. Letter from VDA to Mr. B., president, New York.

Mr. S. has asked us to send you a photostat of the latest drawing of the 4-pocket divider. . . . This is a more complicated machine than the mixer and to date has gone through many changes. He believes we have now got a design which will be economical to manufacture and fulfill all operating requirements. . . . We are now building a scale model of this and will send photos from different angles.

June 10. Letter from Mr. S. to VDA.

The draftsman on this job is working out some of the problems that have come up on the divider and we find, as we get deeper into the subject, that further modification may be necessary. I believe that by the middle of next week we should have another conference to settle as many of these items as possible. Can you arrange to come to Saginaw next week? . . . Mr. P. (VP and GM) has just returned from Europe and I am sure he would like to go over these designs with you. . . .

June 15. Meeting at Saginaw with Mr. P., engineers, and designers.

Memo: Quarter-size model was presented (Plate 15, No. 8). Generally well received, although it was felt that front end view was better than rear. Doubt expressed about enclosing mechanism so completely—that it might have some disadvantages. . . . Dough-box cover should be about 1 inch wider on each side. This will allow the hopper to come inside this form as it continues to the back of the machine. . . . Control panel will be at 30° angle unless otherwise instructed. A retractable step will lift up and drop into a slot for the operator to stand on. . . . The control panel to be a casting—engraved calibrations on a separate ring and a separate etched name,

switch, and data plate. . . . VDA to send sketch. . . . BP to send information on duster and its controls.

June 17. Changes in quarter-size model were begun.

June 18. Letter from BP to VDA.

We are sending you herewith blueprints of three different layouts of the divider, showing the principal dimensions at its present stage of development. . . . We regret that we are unable to give you details surrounding the duster and control adjusting mechanism as we have not found a satisfactory mechanical solution. As soon as we have this worked out, we will send you sketches and full information. . . . One point of difficulty is that the clearance between the bottom of the division box and the retractable step is going to be very close at the point where a man is likely to reach through from the front of the machine. This is likely to be a serious hazard and should be given more thought. . . . We trust this information will enable you to proceed with completion of the design of the main exterior forms.

June 19. Letter from VDA to BP.

In accordance with suggestions made at our last meeting we are enclosing "roughs" on the treatment of the main control panel. Patent numbers are not included on these sketches but will be placed on a separate plate of their own. When you have information on the style of start-and-stop button (shown in center of sketch), please advise.

July 1. Meeting at Saginaw, with VP and GM, engineering department, and designers present.

Memo: Model resubmitted. Further changes to be made are as follows: Leave out words "4-pocket" on name plate. . . . Make space between bands narrower to harmonize with the mixer design. . . . Attachment of the stainless steel bands was discussed—possibly painted metal retainer strips and Phillips-head screws. . . . VDA to make final dimensioned drawings on all factors relating to appearance.

July 3. Letter from BP to VDA.

We are enclosing a blueprint giving the information required on the divider name plate. . . . We have not attempted to balance up the lettering on this plate but merely submit this as a suggestion of how the information can be arranged and grouped to the best advantage. . . . It is only on Canadian name plates that we require the legend "Made in U.S.A." It might be well to keep this in mind so that it can be provided on plates that carry the BP Ltd. name with the Toronto address. . . .

July 6. Changes in model completed.

July 7. Letter from VDA to BP.

We are sending you today the divider model together with enlarged photographs taken against a neutral background. . . . The bands have now been brought closer together and possibly look a little heavy in the photo. This is minor and can be corrected later in the final drawings. . . . We have eliminated the retractable step, and you will find a new hole and scored lines just below the control panel. This is a slide-out step with a recessed under-grip handle of stainless. The thickness shown (3 inches) will probably be necessary for ample gripping, the shelf being faked equally thick for line-up appearance. We will send you a diagram of this soon. . . .

July 15. The second revision of the quarter-size plaster model was shipped to Saginaw. We proceeded with dimensioned drawings on the housing and full-size details of control plates with dials, lettering, etc.

July 22. Letter from VDA to BP.

Last night we sent you our print No. C762 giving final dimensions. . . . The lettering panel in full detail is completed and merely has to be dimensioned. . . . A number of other details such as wheels, knobs, handles, etc., will follow as rapidly as we can complete them.

Aug. 2. Letter from the vice-president to VDA.

Our president is here from New York and we have discussed the mixer and divider models at some length. The mixer is all that we expected, and we are going ahead with it. . . . But frankly we look with some doubt on the divider. We think it should be given further thought, especially as regards the treatment of the rear end. . . .

Aug. 4 to 18. In accordance with the above letter and subsequent information obtained over the long-distance telephone, we made several changes in design. The chief objection seemed to be that the end appeared squat and "boxy." By working out certain rearrangements of the mechanism with the engineers, we contrived to create an offset the entire length of the machine which followed down the back, giving a kind of "strap" appearance. This effectively reduced the *apparent* width without reducing the shaft lengths. BP factory equipment includes a radius former, capable of making a radius on rounded corners up to $2\frac{1}{2}$ inches, and we had kept to this limit in our former design. Mr. P., however, said the company would buy a larger machine to execute the new design. In the new model, radii were consequently

enlarged and softened. An entirely new plaster model did not seem necessary. Instead, a clay model was made, given several coats of casein, and sprayed with white lacquer (Plate 15, No. 9).

Aug. 20. Meeting at Saginaw with Mr. P., engineers, and designers present.

Memo: The new model was presented, side by side with the former plaster model. . . . Mr. P. liked the new design better, but considered the radii now a little too large. VDA will reduce them to three inches to try the effect. To date the chief stumbling block in the design of the divider has been whether to enclose the division box completely in such a way that it would move up and down inside a stationary enclosure, or (a) leave the mechanism entirely exposed, redesigning the component parts; (b) cover the mechanism with an enclosure which would move with it. . . . The revised clay model was designed in accordance with *b* above. A new BP study on the mechanism has made it possible to narrow up the whole mechanism and get it within a moving case. . . . Upshot of the discussion was a decision to design a moving enclosure, adapting this to the changed radii and modified forms shown in VDA's clay model. VDA to rework this model to show new contours. . . . If this procedure is adopted, it was felt some transitional shape should be introduced at the rear of the hopper. . . . Mr. S. pointed out that the main shaft at the rear came out at a bad point on the radius. VDA agreed to reduce the radius slightly and extend the whole casing two inches to avoid this complication. This will not increase the total length at the floor line beyond the present four-pocket design. . . . VDA to revise the model again and make tracings.

Sept. 26. Letter from BP to VDA.

Last Wednesday we sent you blueprints of three sketches and layouts for the four-pocket divider. . . . The large drawing shows the outline of the divider in three views with dimensions of the outside contours. We believe this is substantially in accordance with the design we have agreed upon. . . . The other drawing shows the plan of the base with the proposed location of the varispeed drive. We have given considerable thought to this detail and wish to call your attention to the arrangement for holding down the machine. We propose to make the setback part of the frame as a loose piece at each end and utilize these parts as hold-down clamps by hooking them over the clips on the main frame as shown. . . .

For another month, minor changes were made, lettering panels redesigned, drawn in outline, and blueprinted for the information of the name-plate manufacturers. Eventually all identification was centered on the duster boxes and division box housing; the speed-control wheel and start-and-stop buttons were placed in a convenient position for the operator close to the con-

veyor belt; patent data was placed on a specially designed plate and relegated to the rear. Final drawings from VDA were submitted Jan. 7. Much work was still to be done at the plant, completion of the general layouts, detailing, preparation of patterns, etc. The finished machine (Plate 15, No. 10) was completed several months later.

Appendix

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A · Glossary

- alloy*. A mixture, by fusing, of one metal with another metal or nonmetal.
- alumalite*. Colored finish in which pigment or dye is added to an anodized surface (see *anodized aluminum*).
- anodized aluminum*. Aluminum with an electrolytic deposit of oxidized aluminum on the surface.
- arbor*. A shaft or bar for holding cutting tools; a spindle or axle.
- armature*. A frame or structure (wood or metal) upon which modeling material is shaped to tentative or final contours.
- assembly (n)*. Putting together the component parts of a machine.
- assembly (n)*. A drawing showing all component parts of a machine in proper relation to each other.
- bayonet joint*. A positive interlocking joint between two members, made fast by a twist or turn.
- bezel*. Border or frame, usually of metal, around a dial or other opening.
- blank (n)*. A piece of metal cut to the approximate required shape before forming, stamping, or machining.
- blank (v)*. To cut metal to shape for stamping, etc.
- borax (adj)*. Cheap, shoddy.
- boss*. A projection above the general surface of a part, usually to form a seat for another part.
- brake (n)*. A machine for forming sheet metal.
- brake (v)*. To edge, fold, or form sheet metal.
- brazed*. To solder with hard solder.
- bulldozer*. A forging or bending press.
- broach*. To machine a previously drilled, bored, or cored hole.
- Butler finish*. Satin finish of metal as opposed to bright or highly polished finish.
- capital goods*. Machines or tools used in manufacturing products for sale.
- chamfer*. To bend or cut angularly.
- chuck*. A contrivance for holding a piece of work or a tool, especially as in a lathe.
- clearance model*. A model of an object in which the outside dimensions accurately define the extremes of the structure and of all external moving parts.
- cloisonné*. Enamel inlaid between partitions. An imitation is made for name plates by baking a transparent enamel over special metal surfaces.
- coin*. To stamp a decoration or design in low, fine relief.
- comprehensive*. Accurately drawn and colored design for printed matter or name plate, actual size.

core. Part of mold that fills the inside of a casting, or holes in a casting, until the metal hardens.

decalcomania (decal). Special process of transferring design printed on gelatin film from paper backing to any object.

detail paper. A heavy paper, usually Manila, which will stand much erasure.

die. Cutting or shaping tool used in press.

die cast. To inject molten metal under pressure into a metallic mold.

draft. Slight slope given to the sides of a cast or molded object to enable it to be drawn from the mold easily.

draw. To shape metal by stretching it with a die.

draw mold. A mold from which the finished piece can be drawn out; that is, having no undercuts.

dry brush. A special technique of painting in tempera, water color, or ink with the brush almost dry.

dummy model. A full-size model, not operating, usually made of wood.

durable goods. See *capital goods*.

escutcheon. A protective or decorative plate—often combined with a handle, hinge, dial, or control.

extrude. To force plastics, metals, or rubber through dies to make special cross sections.

extrusion. Form resulting from the above process.

fillet. The inside radius at the juncture of two planes.

fin. A projecting rib or flange.

finish. To cut or grind a surface to its final dimension, usually to a close tolerance.

flash. Excess material squeezed out of a mold, in pressure molding or casting.

flash-weld (or butt-weld) (v). To make a continuous weld by fusing with a torch, or electrically, and with the addition of metal.

forge. To shape metal in manufacture by heating and hammering with a forge press.

form. To shape on a press.

frisket. Special paper used for masking airbrush drawings.

frisket knife. Knife for cutting frisket.

gauge. Measure of thickness of wire, sheet metal, etc.

grommet. Eyelet.

hex-head. A screw or bolt with a six-sided head.

hob. A tap-like cutting tool, for gears, worms, etc.; a hardened steel block with a raised design on its face, used for sinking an embossing die or mold cavity.

incise. To cut a fine line in, as with engraving.

jig. A device to hold work and guide cutter or drills.

Keller machine. Pantographic machine for reproducing three-dimensional contours of an object. Much used in making stamping dies involving freehand forms.

knurl. To bead or roughen, especially hand wheels or knobs.

lapping. Process of producing extremely smooth, accurate surfaces, as in valve grinding.

- logotype.* Usually the name of a company designed in such a way as to form a permanent trade-mark.
- lug.* A small projecting ear on a casting.
- machine.* To cut or shape an object by machine tools such as lathes, planers, drilling machines.
- mandrel.* A supporting spindle for work being machined.
- mat.* Border or frame around a drawing, usually made of cardboard.
- mat knife.* A short knife for cutting mats.
- matt finish.* Dull, lusterless treatment of surface.
- mill.* To cut a true surface on a rough casting.
- miter (n).* A beveled joint.
- miter (v).* To cut on a bevel.
- mock-up.* Full-size model, usually accurately done to simulate the finished product.
- passe partout.* Gummed binding or bordering tape, made in various colors and metallic finishes.
- pattern.* Wood or metal form around which sand is packed to shape molds for castings.
- piece mold.* A mold which is composed of two or more component parts.
- press.* A machine tool with a bed, or anvil, which is approached by a ram or hammer.
- press fit.* Very tight fit between two metal parts, also known as "force fit."
- piercing die.* A die used to stamp holes in sheet metal.
- reamer.* A tool to enlarge or finish previously drilled, bored, or cored holes.
- rendering.* A drawing which represents an object not yet made, hence imaginary.
- reveal.* The setback of one surface from another.
- rough grind.* To take off the worst irregularities from a sand casting.
- rout.* To cut away material with a gouging tool.
- sand blast.* To blow sand with compressed air for cutting, engraving, or cleaning.
- scale (n).* A ruler with accurate graduations for varying proportions.
- scale (v).* To measure with a scale.
- scale model.* A model of an object done to accurate proportion though usually smaller than the finished or proposed object.
- serrate.* To notch or cut teeth in an object.
- shop drawings.* Complete drawings for the actual manufacture of a product.
- silk screen.* Stencil paper mounted on silk. Paint will squeeze through silk, but not through paper.
- slip fit.* Fit between two metal parts with only enough clearance to allow separation without great force.
- spin.* Substantially: to form a metal disk into shape by rotating at high speed while pressing it against a chuck of proper contour.
- spinning.* An object formed by the above process.
- spline.* A flexible celluloid strip for drawing irregular curves, held in place with weights called "geese." Also, a key in the form of a flat strip for insertion in a slot or groove between parts.

spot-weld. To join metal by fusing in one or more spots with electrical resistance.
surface gauge. Gauge to measure depth, especially of irregular concavities, as the depth of a saucer.

swage. Tool for shaping metal by striking with hammer or sledge.

swatch. A piece of cardboard, metal, or glass usually with a sample color painted on it. Also, a small sample of fabric, paper, or other material.

sweat. To join pieces of metal by placing them together with solder between, and heating till solder melts and joins them.

synthetic. Chemical combination for molding or casting, such as synthetic resins.

tap. To cut threads in holes for studs or bolts.

tempera. Opaque water paint.

template. Usually a thin metal plate or board which is used as a pattern, guide, or shaper in modeling or mechanical work.

tolerance. The amount of discrepancy allowed between the specific dimension and the actual dimension of any so designated distance on a manufactured object.

turn. To shape on a lathe.

transfer. See *decalcomania*.

vignette. To shade a drawing off gradually toward the edges.

wash drawing. A drawing made with a brush in transparent paints or inks, usually monochromatic.

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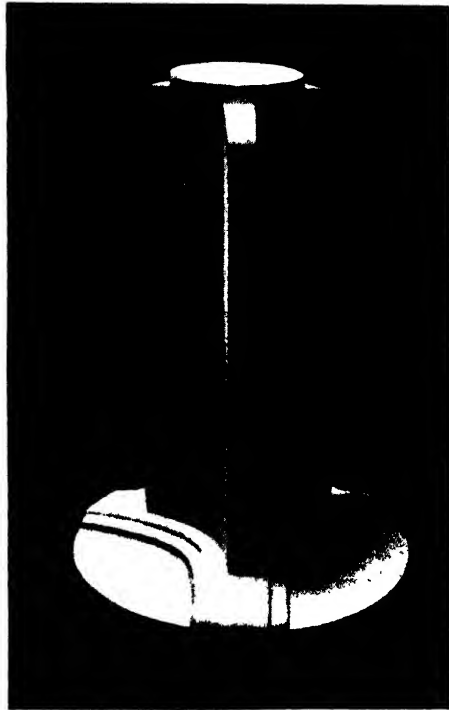
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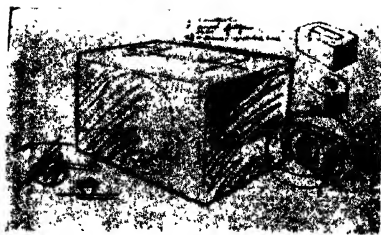
STUDENT ABSTRACT STUDY



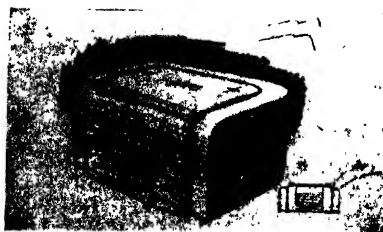
PRATT INSTITUTE

AN EXPLANATION OF THE PLATES

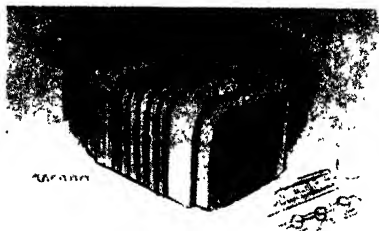
The following photographs serve two purposes: first, to illustrate the text in cases where line drawings cannot tell a complete enough story; and second, to display a representative group of successful product designs. The latter were chosen chiefly for sales success. Attractive appearance as an end in itself was subordinated, for beauty as such is meaningless unless it brings the client increased revenue.



Making a start . . .



A theme emerges . . .



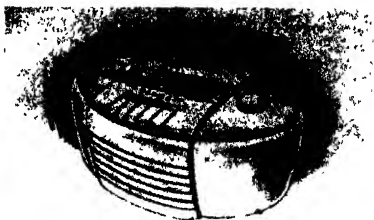
We elaborate . . .



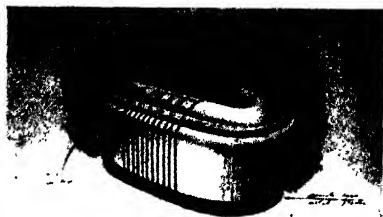
Better visibility . . .



A radical change . . .



Better, but too radical . . .



Getting warmer . . .



Now we have it!

Eight preliminary stages in the rough visualization of a plastic radio cabin



Graphite sketch, the last of a series of rough visualizations (see Chap. XVI).
Made with graphite sticks on layout tissue, details added with soft pencils.



THREE STAGES IN THE PREPARATION OF AN AIRBRUSH DRAWING



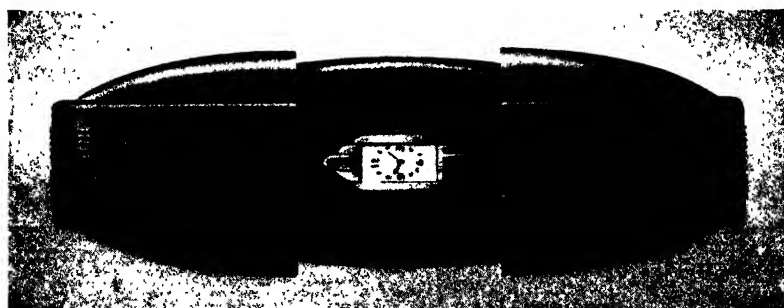
The watch box opposite was rendered in full color. Above, left, the frisket is being cut, using a French curve to guide the knife. Above, right, a shaded effect is obtained with cardboard stencils. Left, a straightedge or cardboard is used to shade around highlights in order to avoid producing hard lines (see Chap. XVIII).



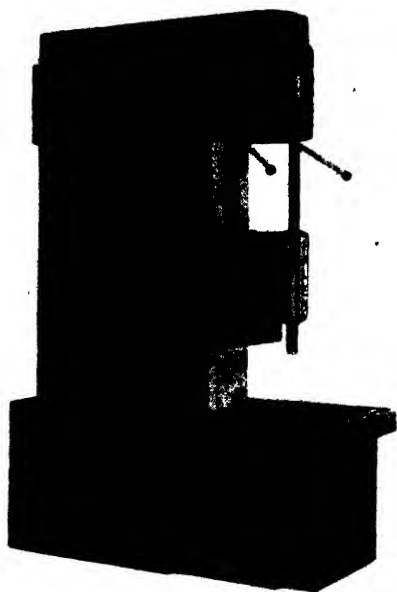
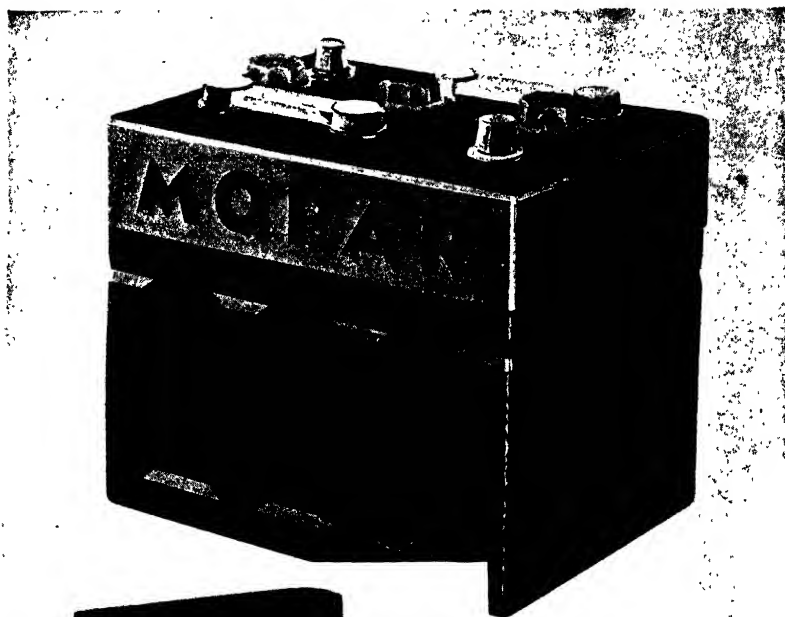
The airbrush drawing before the final retouching and addition of highlights.



How not to do it. The general form is heavy and the highlights are too coarse.

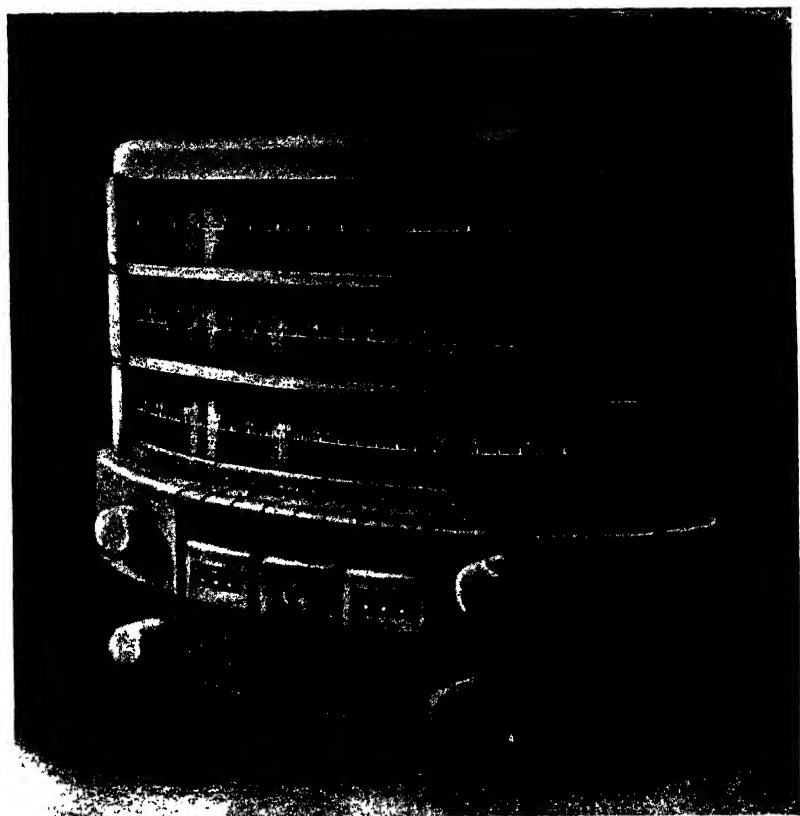


The finished drawing as presented to the client. Note the soft and gradual shading and sharp details touched in with a ruling pen filled with tempera.



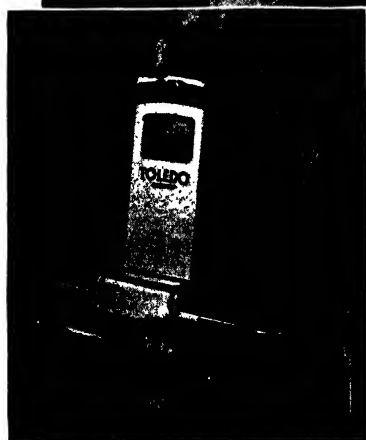
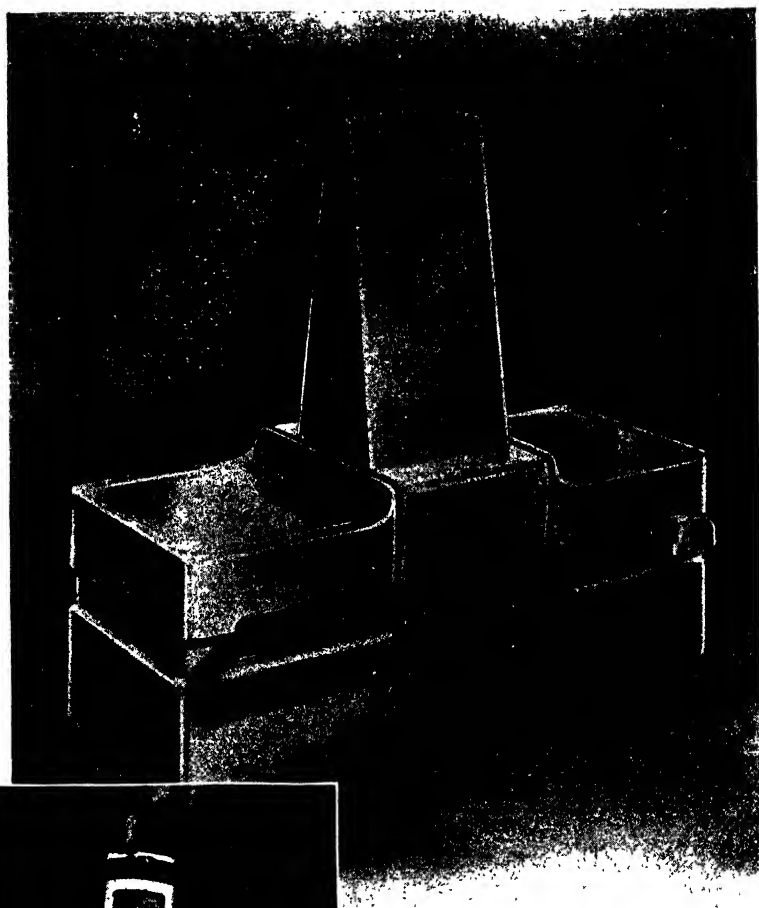
Above, tempera drawing of a battery case in black and two colors (see Chap. XVIII). Left, machinery rendering executed by the rubbed process described in Chap. XVI. Highlights removed with kneaded eraser and accents added with Wolfe crayon. On layout paper.

TWO TYPES OF VISUALIZATION



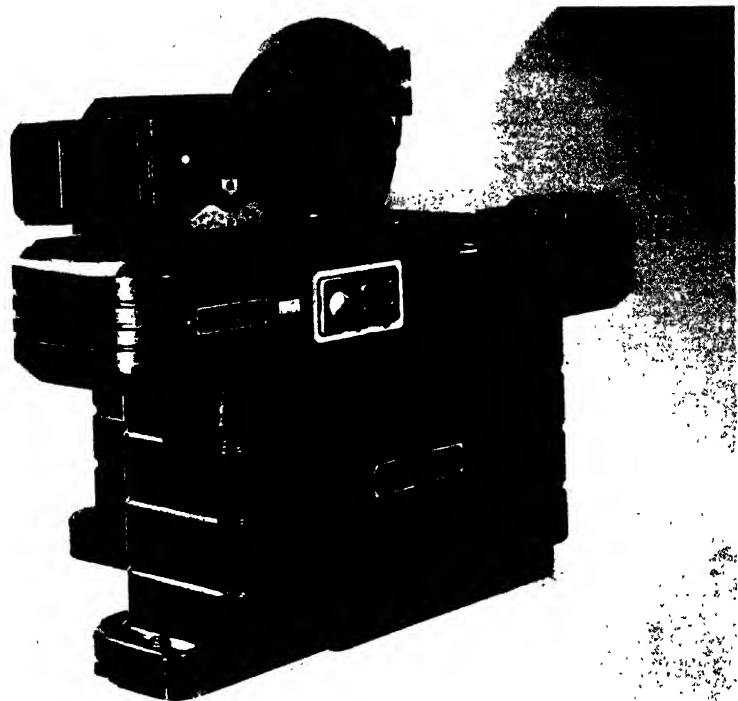
A HARD PASTEL RENDERING

Molded plastic dial for a console radio. This sketch was executed in Nu Pastel on a blue-gray catalogue cover stock. Fine effects may also be obtained with these chalks on an extra-fine sandpaper made especially for this kind of pastel work. Numerals and fine details added in tempera paint with a sable brush.



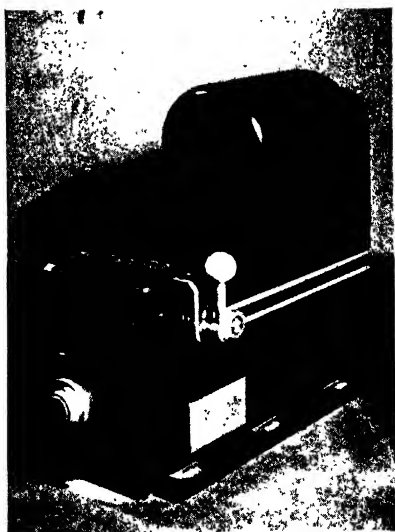
Another example of hard pastel rendering, less finished than Plate 6, made for a preliminary conference with the client. A close resemblance of sketch to finished product — an unusual occurrence.

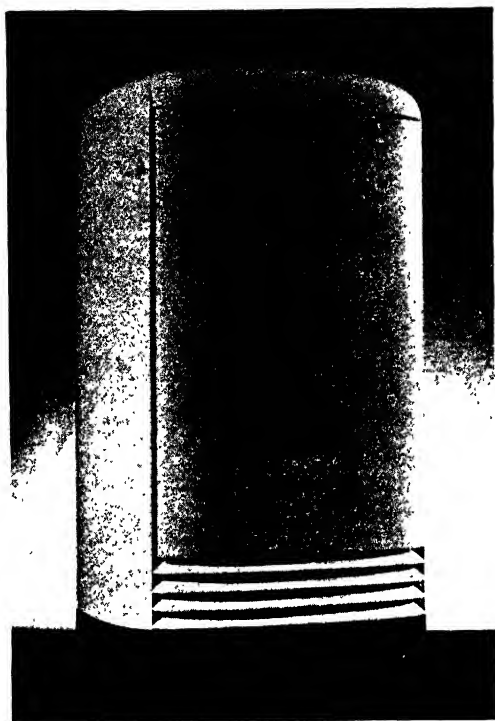
A PREDETERMINED-WEIGHT SCALE



PAINTED CLAY STUDY MODELS

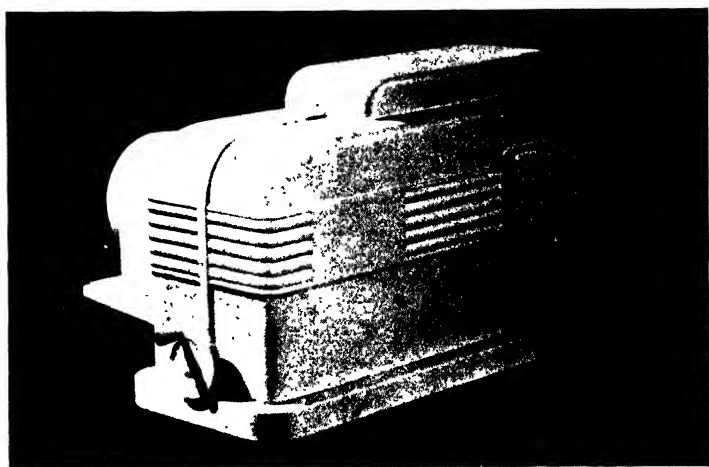
Above, a carefully finished clay model of the machine shown in Plate 21. Sized with casein and painted machine-tool gray. Operating parts only approximated. At right, a hydraulic power unit, also modeled in clay over a wooden armature. Here the motor was approximated with turned wood.

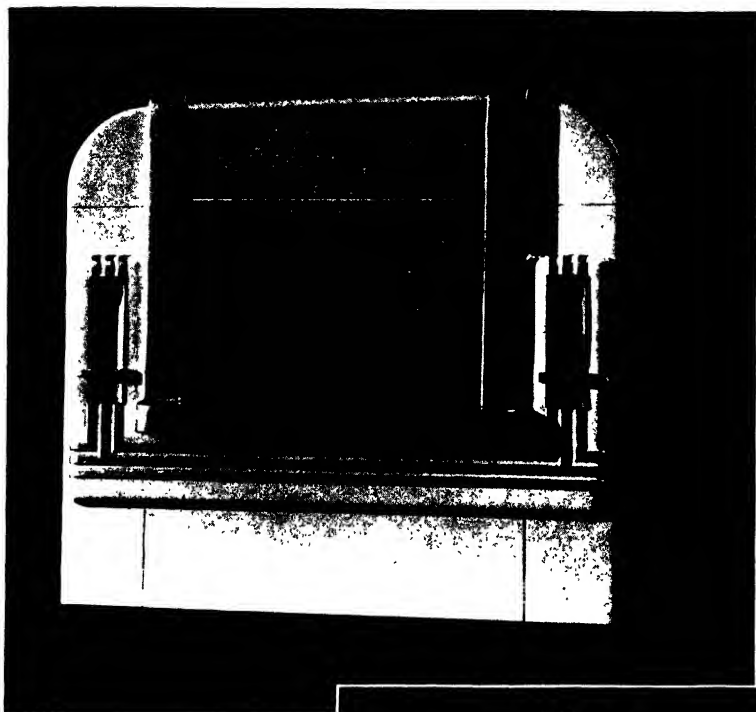




PLASTER MODELS

Presentation models require great care. The built-up type at left is shown before addition of hardware and identifying plate. Finished with casein and seven coats of lacquer to represent baked enamel. Below, study for a motor drive.





Another built-up model, one-eighth size; a commercial dough mixer. Finished in white and aluminum lacquer. . . . Right, a hard plaster "negative," made three times size as a guide to diemakers for the rubber heel, Plate 28.



BUILT-UP AND CARVED MODELS



VAN DOREN ASSOCIATES

FIVE PRODUCTS STREAMLINED FOR SALES

VAN DOREN ASSOCIATES



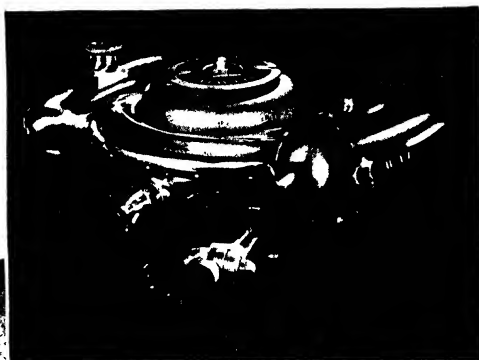
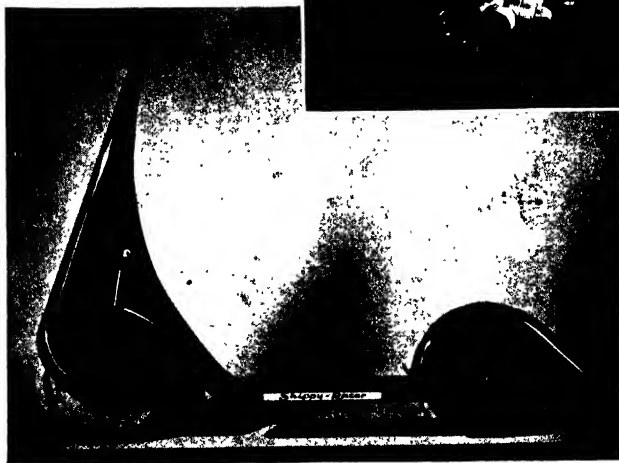
Above, a tot bike for American National. Below, a meat grinder for Enterprise Manufacturing, of cast iron and drawn steel (see Chap. XXVII).



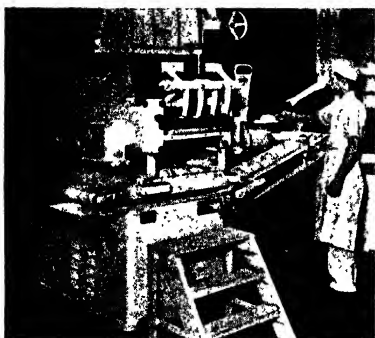
DON HADLEY

Westinghouse iron and
the American National
scooter set new styles.
Sears, Roebuck's out-
board attracts youth.

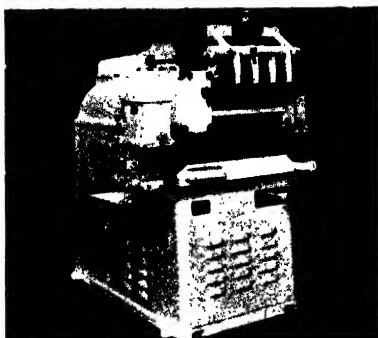
J. G. RIDEOUT



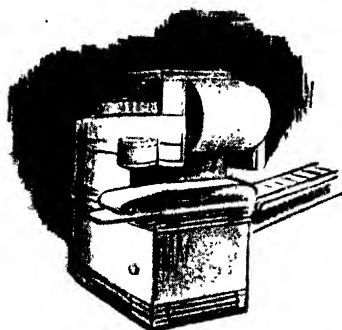
JOHN MORGAN



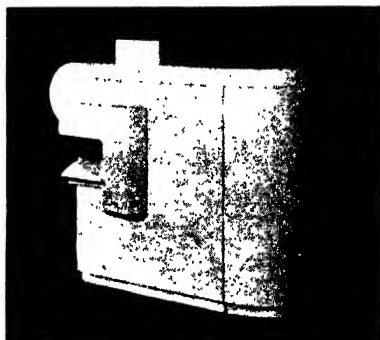
A commercial bakery . . .



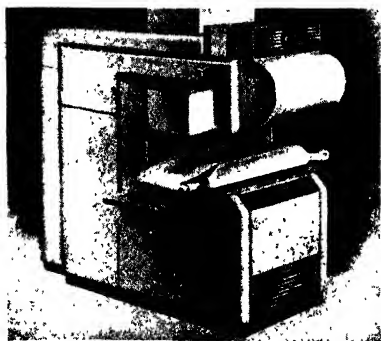
The former machine . .



First rough sketch . . .

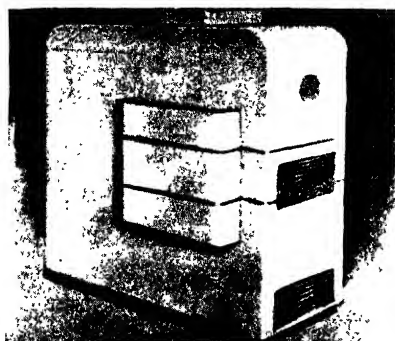


A study model . . .



First rendering . . .

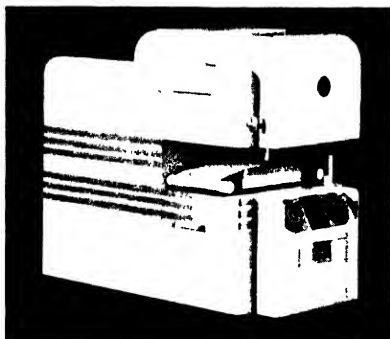
Ten pictures showing progress of a design in the capital goods field: a four-pocket dough divider for Baker Perkins, Incorporated. A case history of this project will be found in Chap. XXVII. For every sketch shown dozens of other studies were prepared.



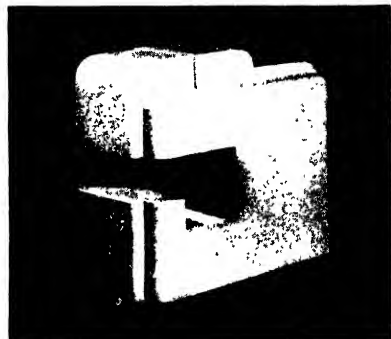
Oversimplified . . .



The design takes shape . . .



Plaster presentation model . . .

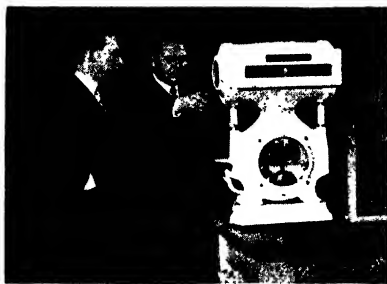


A modification in clay . . .

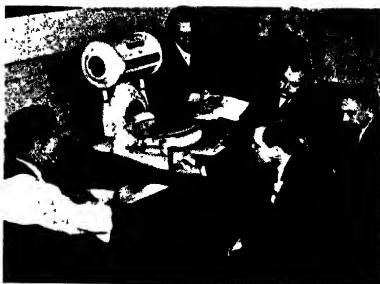
Only the closest cooperation between designers and engineers will make such a program successful. Best results are obtained if design is undertaken when major engineering changes are proceeding concurrently. Other machines were developed simultaneously.



The final design.



Preliminary investigation . . .



Executive conference . . .



Rough visualization . . .



First mechanical layouts . . .



Full-size clay study . . .

After introduction of the Toledo Sentinel scale (see Plate 18), it soon became necessary to offer a matching high-cylinder model. Peculiar shape precluded a single cavity mold, hence the housing was molded in 8 separate parts.

ELEVEN STAGES IN THE DEVELOPMENT OF



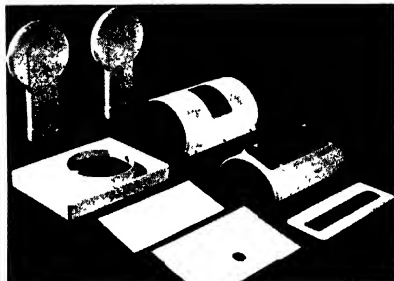
Color rendering . . .



Wooden mock-up . . .



One end plate from the mold . . .



Eight component parts . . .

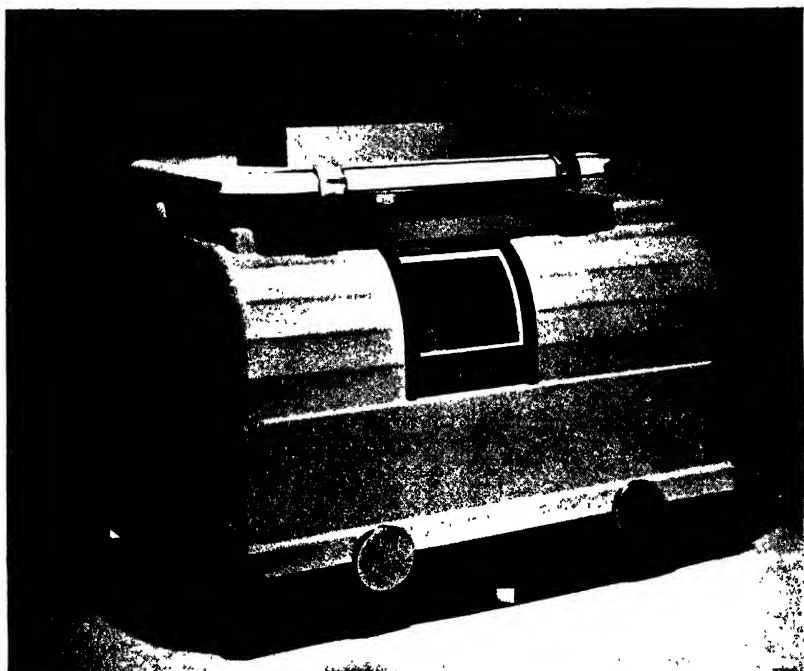


Assembling to chassis . . .

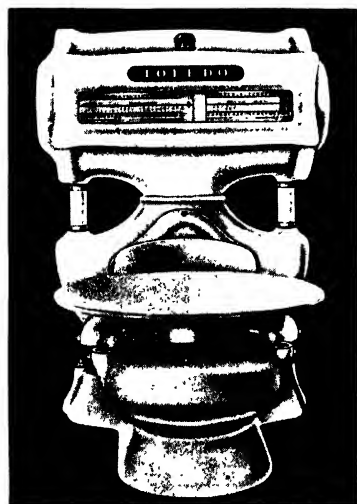


The product in use.

A CYLINDER SCALE FOR RETAIL STORES

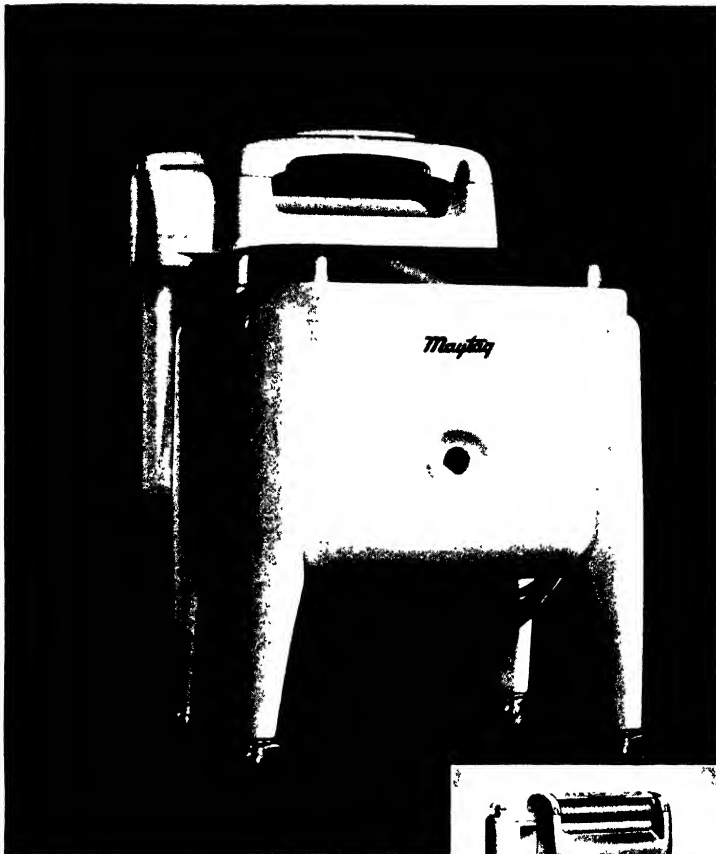


VAN DOREN ASSOCIATES



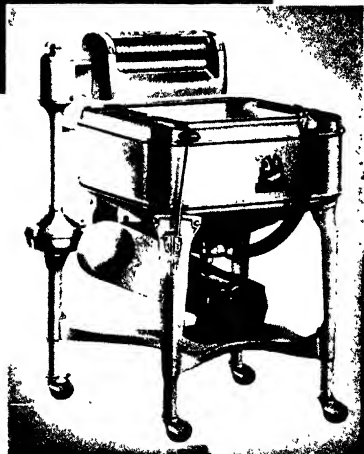
DESIGN FOR POINT OF SALE CONVENIENCE

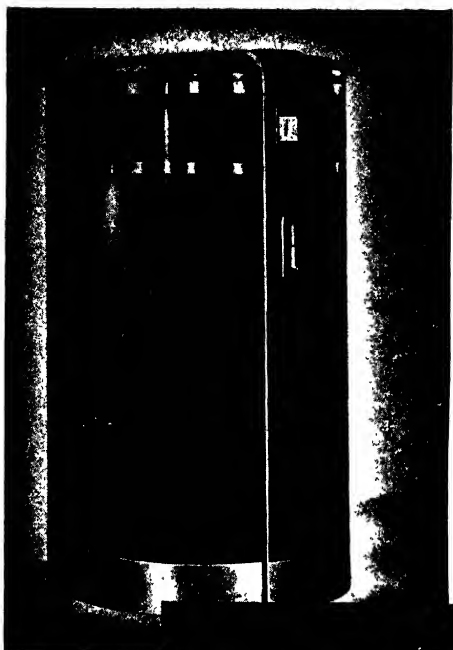
The Sentinel scale made by Toledo was the result of seven years of research and study. Weight was reduced nearly two-thirds, enabling salesmen to demonstrate it on the customer's counter (see Chap. XIV). Housing is one-piece Plaskon molding. At left is shown the cast-iron model weighing 165 pounds that it replaced.



VAN DOREN ASSOCIATES

Another example, together with the scale opposite, of total redesign. Four years of development, combining efforts of appearance designers with Maytag experimental engineers, were needed. Greater capacity, safer operation, and concealment of unsightly mechanisms are features.



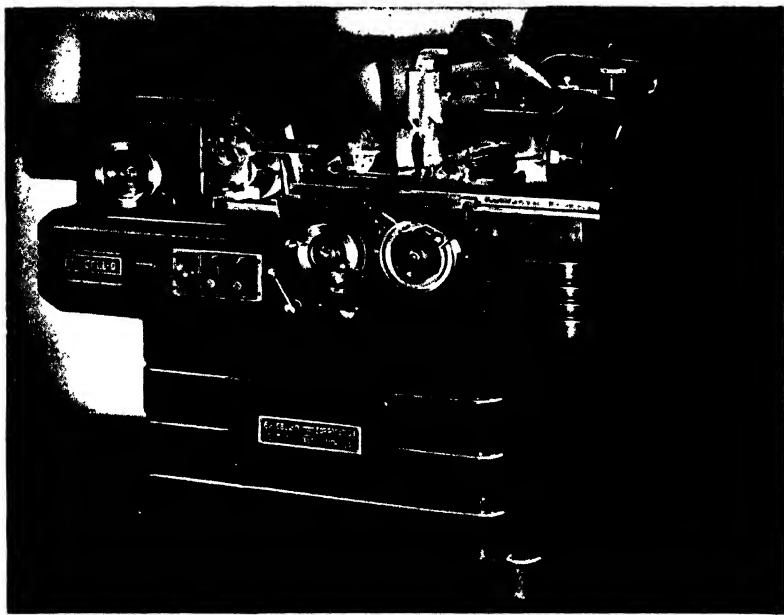


General Electric's sturdy oil burner brought marked increase in public acceptance. Simpler to manufacture and easier to assemble than its predecessor, it effected a net reduction in price to the consumer of 10 per cent. Side walls of a Goodyear Double Eagle tire, designed for richness of detail plus simplification of sales data.

G-E STYLING



VAN DOREN ASSOCIATES



IDENTIFYING THEME

Two machines of a series for Ex-Cell-O styled to carry one theme through a line. Radii and vertical ribs were avoided because other makers had employed them. . . . Distinctive appearance was obtained by the use of parallel bands and chamfered horizontal edges.

VAN DOREN ASSOCIATES

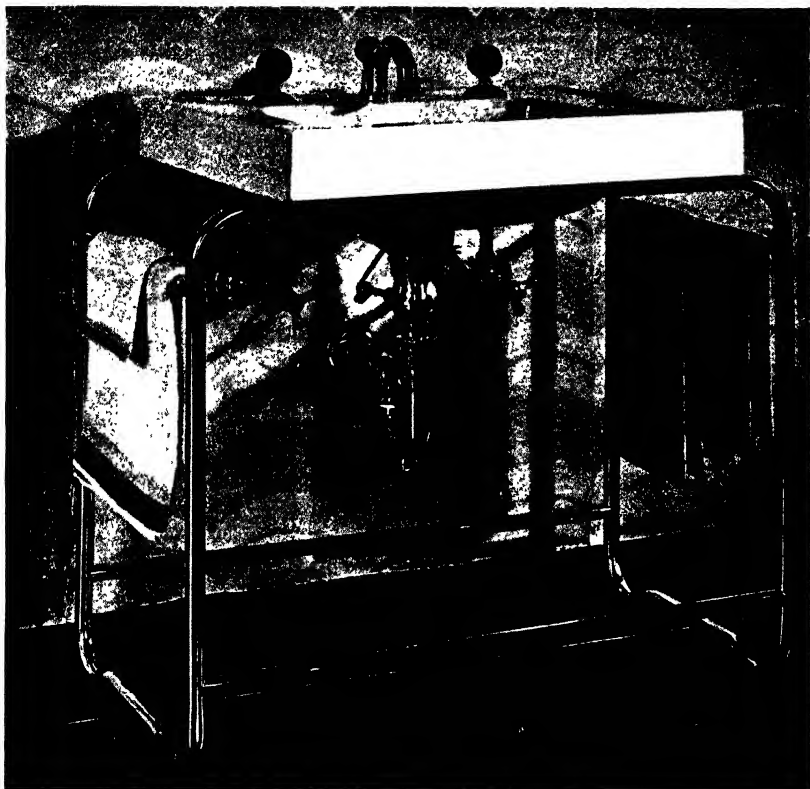




HENRY DREYFUSS

A VACUUM CLEANER

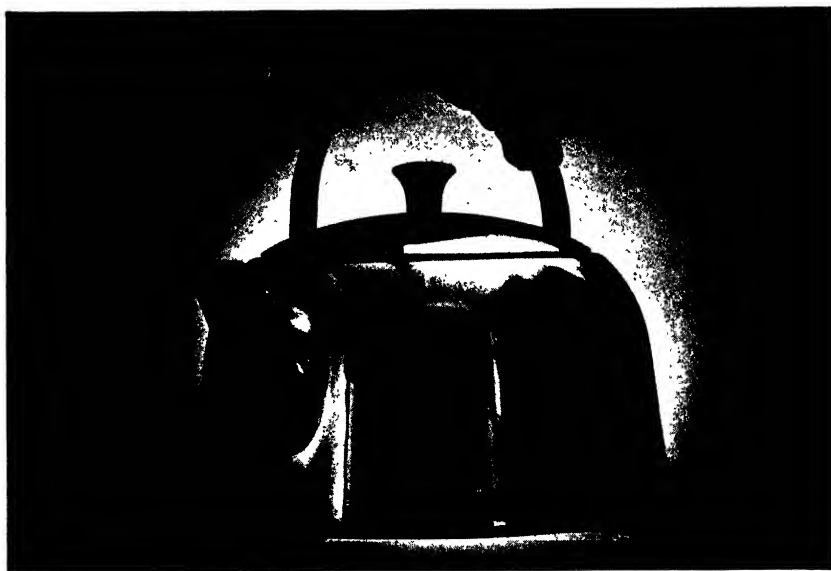
A smart tool designed for an essentially uninteresting task. Smoothing out of contours produced a kind of streamlining essentially functional. Floor tool is cast of a magnesium alloy (see Chap. XXIV). Motor hood is a phenolic molding. Weight was thereby reduced over 30 per cent and sales have boomed.



GEORGE SAKIER

A staple household item,
a bathroom lavatory.
Chosen for Atlantic
Clippers. Fittings are
the last word in sim-
plicity for mass pro-
duction. Balls unbreak-
able, although of china.

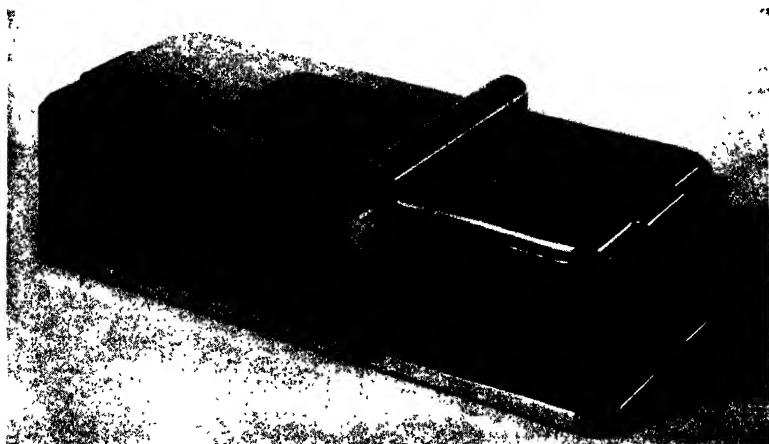


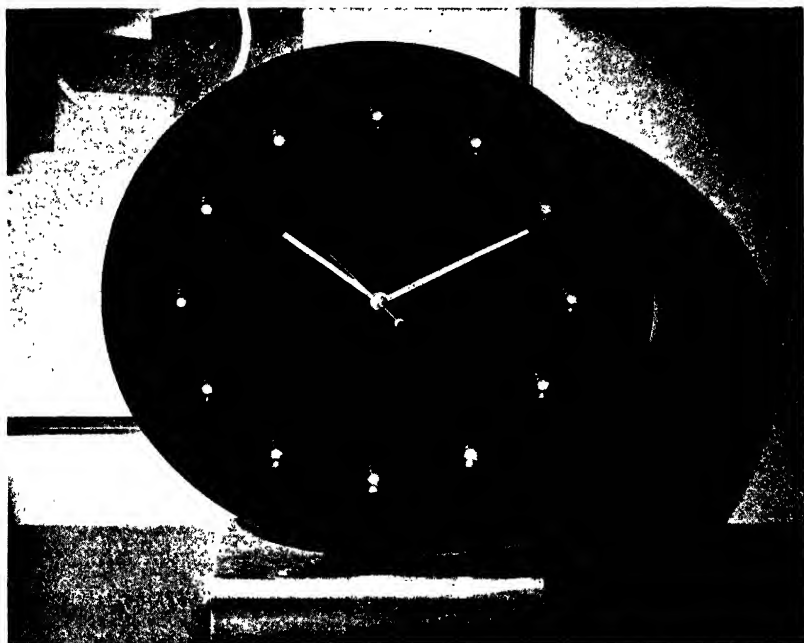


LURELLE V. A. GUILD

Above, a design that revolutionized a household necessity: Aluminum Cooking Utensil's teakettle; see Chapter IV. Below, an autographic register for American Sales Book . . . Cheaper, easier to assemble.

WALTER DORWIN TEAGUE



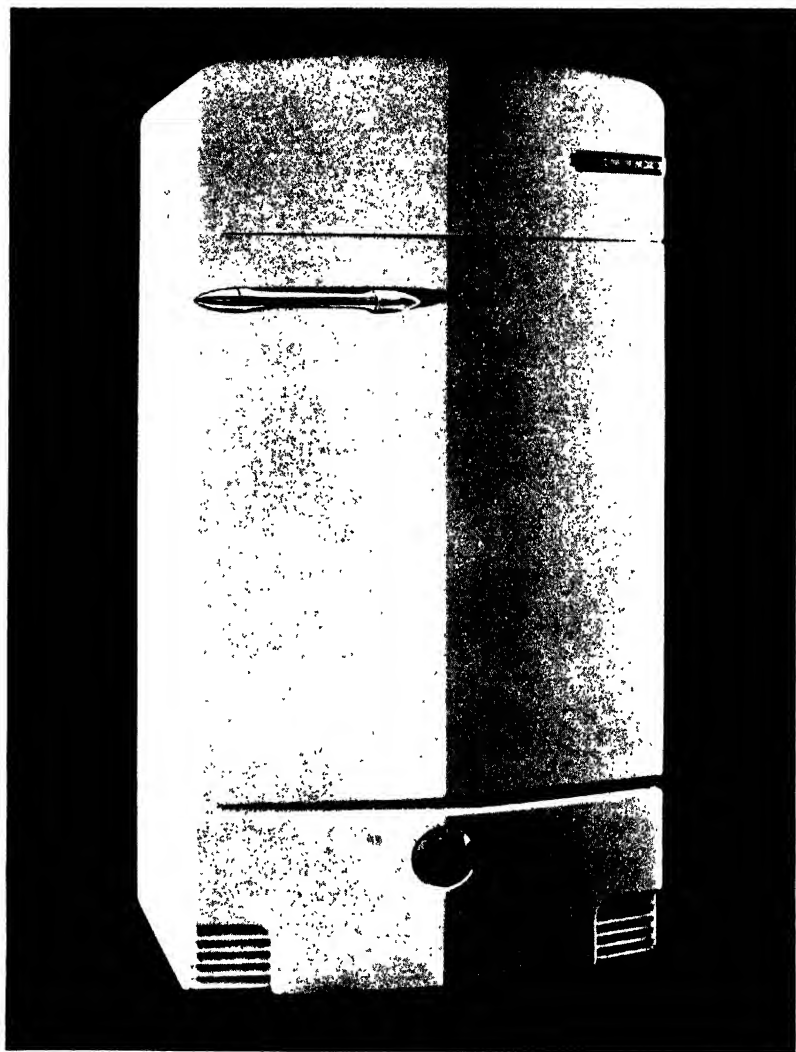


GILBERT RONDE

A mantle clock in glass and brushed chromium for the Herman Miller Co. Starkly simple, but perfect spacing lends subtlety. At right, the handbag watch designed in 1932 for Westclox was the outcome of an observation that women like to carry an inexpensive watch in their bags. Presented as a novelty it ran for five years and sold twenty-three times the minimum necessary to cover expense of tools and dies.

DE VAULCHIER, BLOW AND WILMET





RAYMOND LOEWY

COMPETITION IS INTENSE IN REFRIGERATORS

Sears, Roebuck's 1938 Coldspot. By that year, through smart design and intelligent merchandising, Sears had climbed from eleventh place to second.

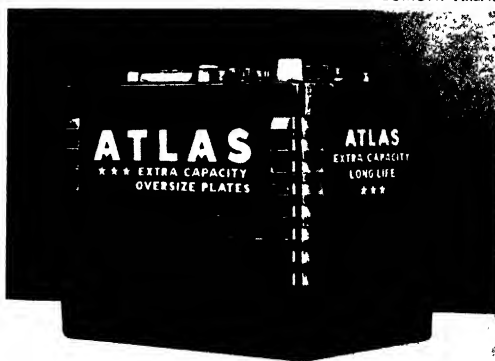


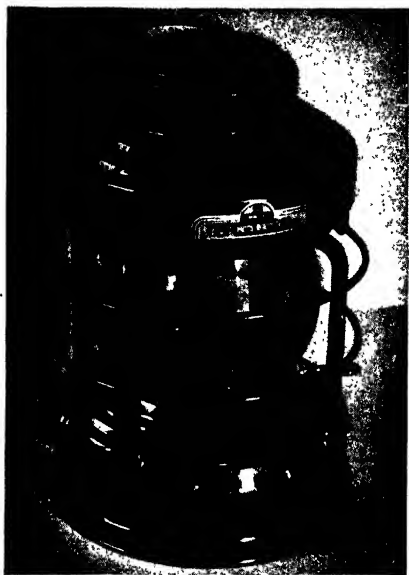
EGMONT ARENS

PRODUCTS NEED NOT BE COSTLY TO
MERIT DESIGN ATTENTION

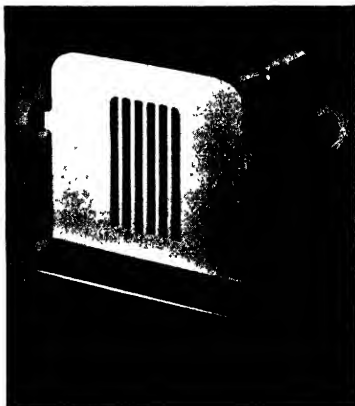
Desk memo for Riddel; 35 per cent increase in specialty sales attributed to this new item. Right, a battery case reversed the volume of sales of the medium and the high-priced lines . . . an example of design for point-of-sale appeal.

EGMONT ARENS





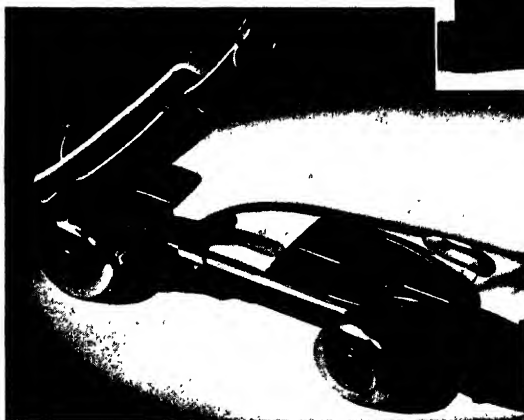
JOSEPH FEDERICO



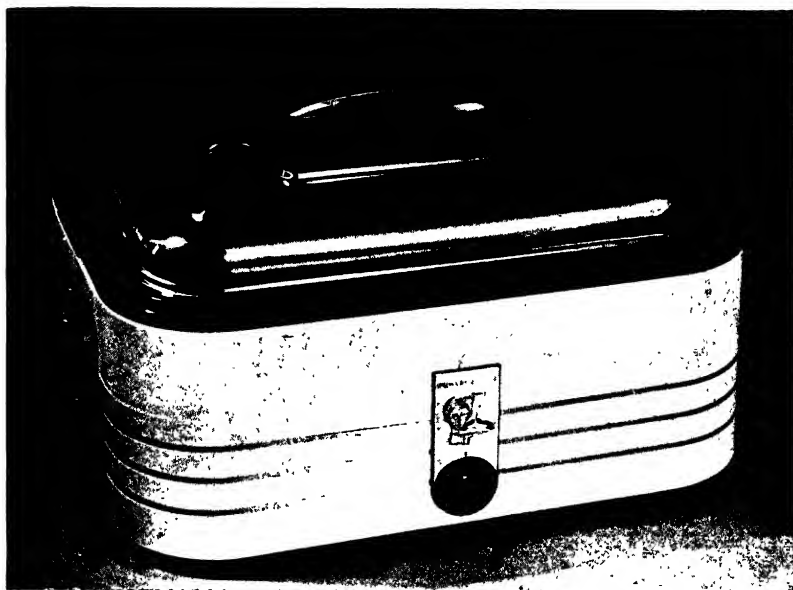
INEXPENSIVE MERCHANDISE

Embury truck lantern; neat dress for an awkward product. Ward's 79-cent toaster: simple, good. Goodyear heel streamlines to foot. Sears's skate has held sales records for five years.

JOHN MORGAN



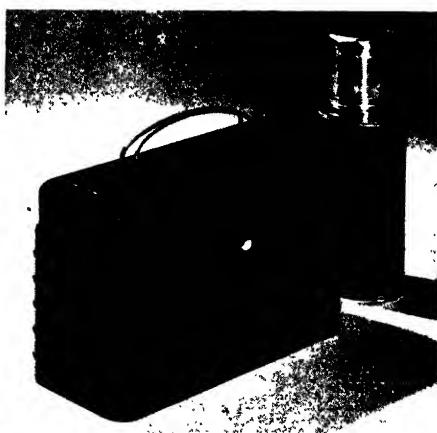
VAN DOREN
ASSOCIATES

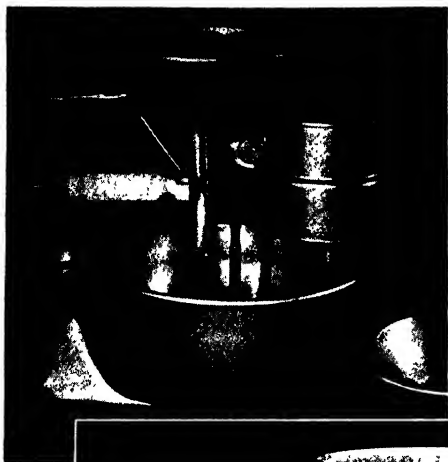


DON HADLEY

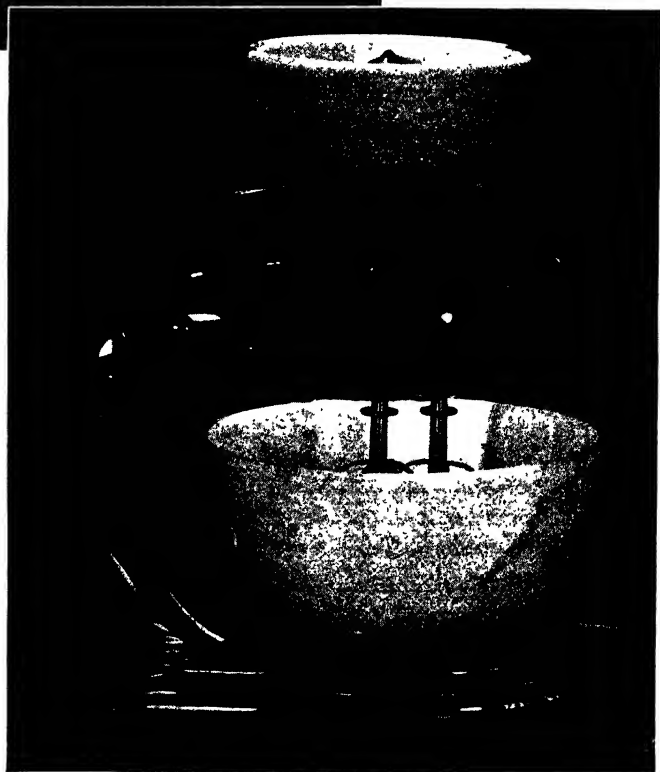
Westinghouse scrapped oval roasters. Result: sales jumped 289 per cent.
Packwood dispenser streamlines nicely. Montgomery Ward's \$1.19 lunch kit.

BARNES AND REINECKE



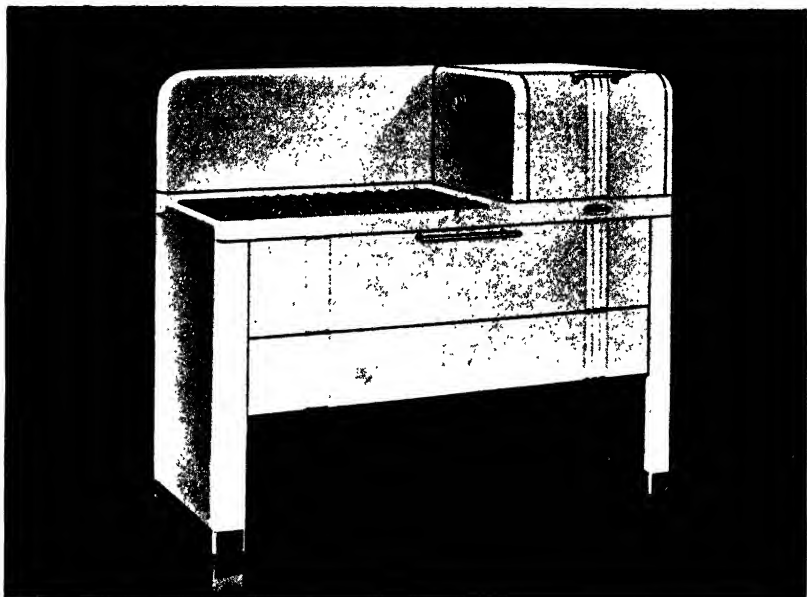


Gilbert Kitchen Kit. Motor housing is a phenolic molding in four parts; base a plated casting. Body weight reduced 32 per cent. Tools 8 per cent higher, but assembly cut 15. Sales up 31 per cent first year. Retail price about the same.



ROBERT HELLER

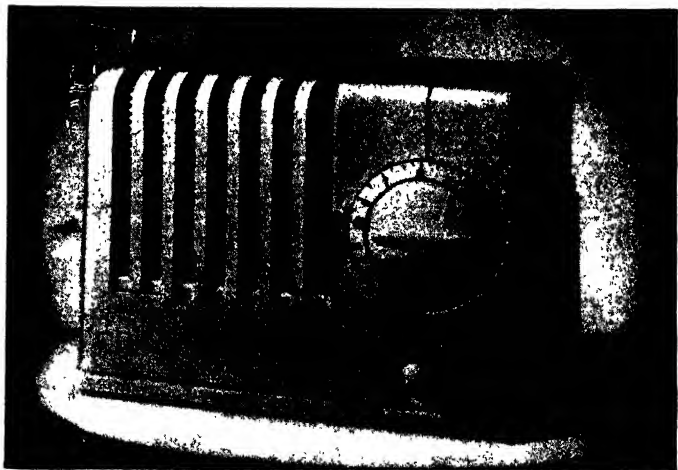
A FOOD MIXER: BEFORE AND AFTER

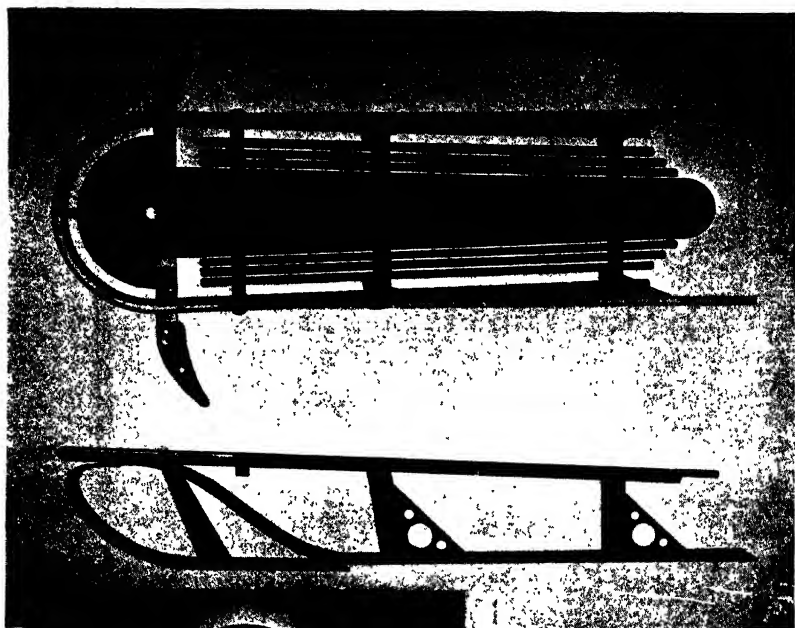


WILBUR HENRY ADAMS

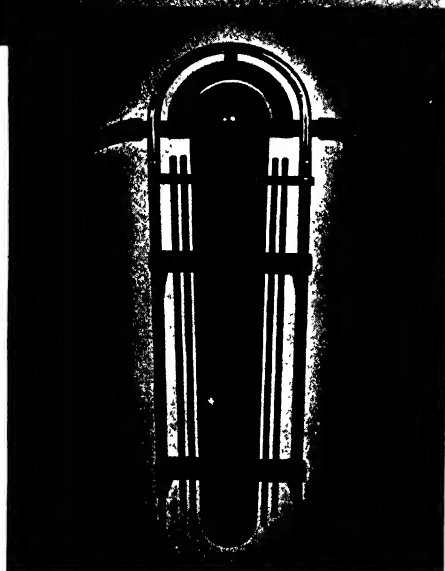
Perfection's oil stove became fastest seller in company history. Note high oven. Sears's Silvertone set a style trend in plastic cabinets that is still felt.

JOHN MORGAN





VAN DOREN ASSOCIATES



Sleds were slow in capitulating to the onslaught of design. The Sno-Plane for American National was the first full-fledged novelty and started a style trend throughout the industry. . . . Above, presentation airbrush drawing in black and red, half size. See Chap. XXVII for case history.

CHILDREN LOVE STREAMLINING

